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FOREST SURVEY RELEASE NO. 1

JULY 15, 1939

FORESTS RESOURCES OF THE NORTHERN COASTAL PLAIN OF SOUTH CAROLINA

A Progress Report

By

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Appalachian Forest Experiment Station
R. E. McArdle, Director
Asheville, N. C.

To meet the demand for Forest Survey information, this progress report on the "Forest Resources of the Northern Coastal Plain of South Carolina" is issued in advance of the final report for the State.

Acknowledgment is made to the Forest Survey staff of the Southern Forest Experiment Station for assistance in assembling the data for this release; and to the Regional Forester, Southern Region, U. S. Forest Service, and Mr. H. A. Smith, State Forester of South Carolina, for review of the manuscript.

Additional copies of this report and copies of forthcoming releases may be obtained by writing to the Director, Appalachian Forest Experiment Station, Asheville, N. C.

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PREFACE

Through the McSweeny-McNary Forest Research Act, of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the research branch of the U. S. Forest Service to carry out the provisions of the act, and each regional Experiment Station is responsible for this work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station with headquarters in Asheville, North Carolina.

The work of the Forest Survey is divided into five major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of the timber on these lands.

2. Growth. Determination of the current rate of timber growth.

3. Drain. Determination of the drain caused by industrial and domestic wood use, and the total loss from fire, insects, disease, suppression, and other causes.

4. Requirements. Determination of the current and probable future requirements for forest products by all classes of consumers.

5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis in formulating public and private policies and plans of forest land use and management.

This progress report presents preliminary information on the first three of these phases for the Northern Coastal Plain of South Carolina, (Forest Survey unit No. 2) one of the three units into which the state was divided. Similar releases are being prepared for the other units, the Southern Coastal Plain and the Piedmont Region. A complete report for the state will be published at a later date.

Information on the forest resources was obtained by a field survey in the fall of 1936. A total of 9,429 sample plots were established at intervals of one-eighth of a mile on compass lines 10 miles apart, extending across the Unit from the southwest to the northeast. The statistical sample obtained from these plot records forms the basis for all area, volume and growth estimates in this report, except where other sources are directly credited. Owing to the statistical nature of the data, small tabular items have the greater probability of error and should be considered as indicating relative magnitude rather than actual values.

The figures on consumption of forest products for industrial and domestic purposes were obtained by canvassing primary wood-using industries and by sampling representative domestic consumers.

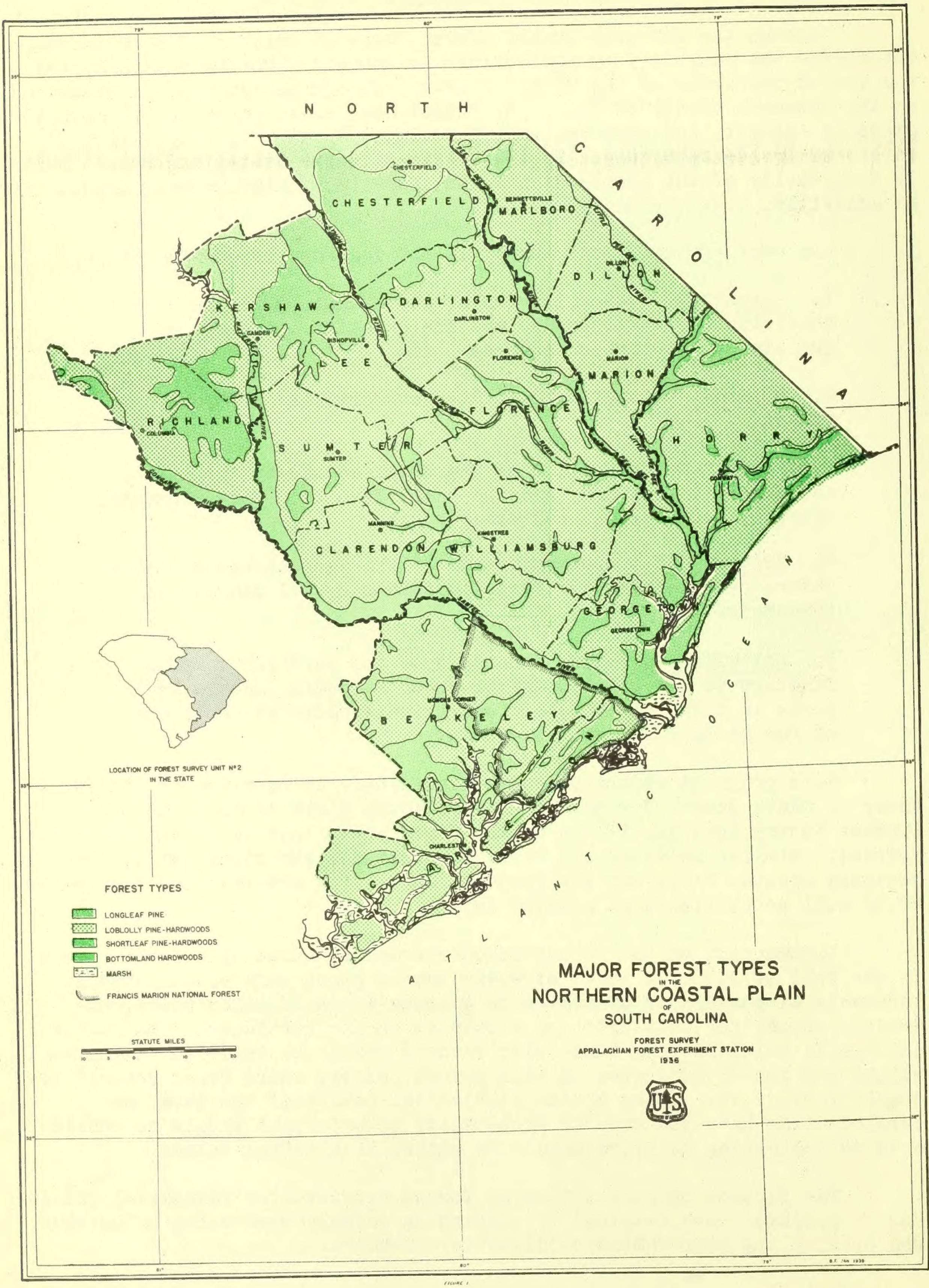
MAJOR FOREST TYPES
IN THE
NORTHERN COASTAL PLAIN
OF
SOUTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1936
FOREST TYPES
LONGLEAF PINE
LOBLOLLY PINE-HARDWOODS
SHORTLEAF PINE-HARDWOODS
BOTTOMLAND HARDWOODS
MARSH
FRANCIS MARION NATIONAL FOREST
STATUTE MILES
10
5
0
10
20
LOCATION OF FOREST SURVEY UNIT Nº 2
IN THE STATE
NORTH CAROLINA
ATLANTIC OCEAN
CHESTERFIELD
MARLBORO
DILLON
KERSHAW
DARLINGTON
LEE
RICHLAND
SUMTER
FLORENCE
MARION
HORRY
CLARENDON
WILLIAMSBURG
GEORGETOWN
BERKELEY
CHARLESTON
Chesterfield
Bennettsville
Dillon
Camden
Bishopville
Darlington
Florence
Marion
Columbia
Sumter
Conway
Manning
Kingstree
Georgetown
Moncks Corner
Charleston
FIGURE 1

Figure 1

K

FOREST RESOURCES OF THE NORTHERN COASTAL PLAIN OF SOUTH CAROLINA

General Description of the Unit

The area discussed in this report is formed by a group of 16 counties in the northeast section of the state (fig. 1). Extending from the sand hills of Richland, Kershaw, and Chesterfield Counties eastward to the ocean the unit includes approximately 7½ million acres, 60 percent of which is forested. One of three units established by the Forest Survey in the state, it is sufficiently homogeneous in its physical and economic characteristics to warrant a separate study of its forest resources.

The topography is that common to the Atlantic and Gulf Coastal Plains. Saltwater marshes, intersected by broad rivers and tidal sounds characterize much of the coast line. These treeless marshes gradually merge into the sandy, pine flatwoods and the broad, hardwood swamps bordering the rivers. Elevation in the coastal area seldom exceeds 50 feet above sea level, and the general land surface shows little relief. Farther inland these conditions gradually change as the successively higher terraces are reached. Here the more pronounced slopes, higher interstream altitudes, and narrower stream valleys give a distinctly rolling character to the land surface. Near the western boundary a narrow, irregular belt of sand hills extends across the entire unit through Chesterfield, Kershaw, and Richland Counties. This is a distinct topographic zone lying between the Coastal Plain and the higher Piedmont Plateau which intrudes into the western border counties of the unit. From elevations of approximately 600 feet in the Piedmont areas the general land surface drops sharply along the eastern edge of the sand hills and thence with a more gradual descent to the flatwoods and marshes along the coast.

Drainage is southeasterly through the Santee and Pee Dee Rivers and their tributaries. With headwaters in the upper Piedmont west of this unit these rivers traverse the sand hills through well-defined valleys. Through the rolling uplands of the Coastal Plain the valleys widen and the stream velocity drops markedly until, near the coast, the main channels divide into many sluggish branches and meander through broad, wooded bottomlands and tidal marshes. The larger rivers are heavily burdened with silt washed from the fields and caving banks in the headwaters above the sand hills, whereas the Ashely, Black, and a few smaller streams rising in the Coastal Plain seldom have heavy silt content.

Throughout the unit most of the soils are sedimentary clays and sands moderately well-drained except in the flatwoods and bottomlands where insufficient gradient and periodic inundation cause surface water to accumulate during the winter and spring months. In the sand hills the deep, coarse-textured soil retains little moisture and is so deficient in many plant nutrients that little opportunity is offered for either profitable farming or commercial timber production.

Although moderate sheet erosion and occasional gullying occur on the abandoned fields and steeper slopes of the upper Coastal Plain, the erosion problem in general is comparatively unimportant over most of this unit.

Transportation and travel facilities are adequate for the needs of the area. The Seaboard Air Line, the Southern, and the Atlantic Coast Line railroads with their subsidiary lines provide rail service for every county seat in the unit. Many inter-connecting carriers, especially in the central agricultural counties, serve all the important manufacturing and producing centers. Only in the heavily timbered portions of the coast counties are there any extensive areas more than 6 miles from railroads. A network of hard-surfaced highways is spread over the entire unit; local farm-to-market and county highways give year-round access to practically all areas.

The Intracoastal Waterway and the navigable channels of the Santee and Pee Dee Rivers with their larger tributaries provide facilities for water transportation. For shallow draft barges and small power boats the natural channels of the Congaree and Wateree are usable as far as Columbia and Camden, respectively. The Santee-Cooper River hydroelectric project being constructed near Moncks Corner will divert water from the Santee to the Cooper River, providing an improved navigable waterway between Charleston and Columbia. The Pee Dee River, now under Federal improvement, has a navigable depth of 9 feet to Smith's Mills in northern Georgetown County. The Waccamaw River is open to shallow draft vessels from the mouth of Winyah Bay to Red Bluff in Horry County. Comparatively little use has been made of these waterways in recent years, although barging of pulpwood and other forest products has increased since the construction of new pulp mills at Georgetown and Charleston.

Charleston is a deep water port with terminal facilities for coastwise and transatlantic shipping. Forest products handled at this port during 1936 totaled nearly 300,000 tons. Georgetown, located on an estuary of Winyah Bay, is connected with Charleston through the intracoastal canal and handles considerable tonnage in forest products, particularly pulpwood, in both coastwise and internal shipments.

The Census of 1930 recorded a population of 660,461 for this area, 53 percent of which was negro. In only 5 of the 16 counties were there more white than negro inhabitants. Charleston, with a population of 62,265, and Columbia, the State capital, population 51,581, are the largest cities in the unit and also in the state. Their influence as marketing, banking, and railroad centers is felt throughout the entire area. These cities, together with Sumter, Florence, and a number of smaller industrial and trading centers contain most of the urban population. The rural population, however, predominates in the area as a whole and accounts for 72 percent of the total. During the decade 1920-30 the Census records a 3 percent increase in total inhabitants notably in Florence, Horry, and Marion Counties. Six counties sustained losses, the largest of which was 14 percent in Clarendon County.

Agriculture is the leading activity in the area. The Census of 1935 listed nearly 60,000 farms and an agrarian population of 370,923, about 56 percent of the total for the unit. In 1936 the Survey found a total of nearly 2½ million acres in cropland and improved pasture located largely in the central counties (table 1).

In Kershaw, Lee, and Florence Counties, according to the 1935 Census of Agriculture, approximately 80 percent of the land area is in farms, including woodlands, while in Charleston, Berkeley, and Georgetown Counties only 20 to 32 percent is in farm ownership. The average farm is about 68 acres, of which 35 acres are woodland. Approximately 61 percent of the farms were leased to tenant operators, over one-third of whom were sharecroppers.

Table 1. - Total land area classified by major use

Land use class	Area		Proportion of total area	
	Acres		Percent	
Forest				
Productive	4,498,400		59.5	
Non-productive	9,600		0.1	
Total forest		4,508,000		59.6
Non-forest				
Agricultural				
Cropland	2,329,400		30.8	
Improved pasture	68,200		0.9	
Abandoned cropland	124,400		1.6	
Marsh	321,000		4.3	
Towns, rights-of-way, etc.	215,100		2.8	
Total non-forest		3,058,100		40.4
Total		7,566,100		100.0

Half of all gainful workers in the unit were employed on farms, according to the 1930 Census. The Unemployment Census[1] taken in November, 1937 indicates that of all unemployed, partially employed or relief workers in the area, 40 percent were farm residents.

In this, as in many other sections of the South, much of the forest acreage is held in small tracts and wood-lots seldom exceeding 500 acres in extent. According to the 1935 Agricultural Census more than 1½ million acres or about one-third of the total forest area is farm woodland. The larger ownerships are confined principally to the coastal counties where extensive agricultural development has not taken place. Large estates and the remnants of old plantations occupy thousands of acres more or less reserved from exploitation. Recreational preserves, managed primarily for game breeding and hunting, aggregate more than 180,000 acres.[2] It is estimated that industrial interests, chiefly lumber and pulp companies, own more than 700,000 acres of forest land scattered throughout the unit. The larger of these ownerships occur principally in the pine flatwoods of the coastal counties and include some of the best timber land in the state.

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[1] Census of Total and Partial Unemployment. J. D. Biggers, Administrator. Washington, D. C.

[2] Estimated by the Division of State and Private Forestry, Southern Region, U. S Forest Service, Atlanta, Georgia.

The United States Forest Service through purchase has established the Francis Marion National Forest in Berkeley and Charleston Counties. On June 30, 1938, the gross area within the forest boundary totaled 414,700 acres, of which 243,283 acres were in Government ownership. Other public agencies are estimated to own more than 200,000 acres of forest and farm land in scattered tracts throughout the unit.

When compared to the Piedmont counties farther west, this part of South Carolina is not highly developed industrially. The textile industry, although rated as the leading manufacturing activity, is confined largely to the three western counties. The harvesting and primary manufacture of wood products, although secondary in importance since the rise of the textile industry, is nevertheless a long established business, widely distributed in all counties of the unit. The recent expansion of the pulp industry involving millions of dollars in plant investment and land purchases in this area has stimulated production of forest products especially in the more heavily timbered coastal counties.

Forest description

The aggregate forest area in this Survey unit in 1936 was 4,508,000 acres -- approximately 60 percent of the total land area (table 1). A small fraction of this acreage was classified by the Forest Survey as "nonproductive".3/ This area, chiefly brush covered sand dunes, showed no indications of past cutting and such poor tree growth that the possibility of future timber production is exceedingly remote. Only the 4,498,400 acres of productive forest land are included in the discussion of forest area.

The Forest Survey recognized three major topographic divisions in the forested areas of this unit. Approximately 2 million acres, or 45 percent of the forest area, lies in a broad belt of flatwoods which parallels the coast and extends inland for about 50 miles. Rolling uplands, which characterize most of the inland areas, total approximately 1,100,000 acres, or 25 percent of the forest area. The remaining 30 percent is in wooded swamps and bays of the flatwoods and in alluvial bottomlands of rivers and streams throughout the unit.

Forest Types

Four major tree associations, loblolly pine, longleaf pine, bottomland and swamp hardwoods, and upland hardwoods, representing the grouping of 13 individual forest types, are used in the description of the forest area.

Loblolly pine with its associates, longleaf, shortleaf, and pond pines, red and black gums, oaks, and species of minor commercial importance, occupies nearly half of the total forest area (table 2). Loblolly pine makes up 69 percent of the total cubic-foot volume in this type-group.

3/ See page 27 for explanation of terms.

Table 2. - Productive forest area classified by forest condition and type-group

Forest condition	Type group				Total	Proportion of total
	Loblolly pine[1]	Longleaf pine	Bottomland hardwood and cypress	Upland hardwood		
	Acres	Acres	Acres	Acres	Acres	Percent
Sawlog size						
Old growth						
Uncut	69,800	7,200	268,800	5,700	351,500	7.8
Partly cut	142,000	55,400	284,900	12,800	495,100	11.0
Total	211,800	62,600	553,700	18,500	846,600	18.8
Second growth						
Uncut	826,500	257,600	287,300	13,600	1,385,000	30.8
Partly cut	385,200	59,400	90,600	8,800	544,000	12.1
Total	1,211,700	317,000	377,900	22,400	1,929,000	42.9
Total sawlog size	1,423,500	379,600	931,600	40,900	2,775,600	61.7
Under sawlog size						
Second growth	572,900	308,900	231,900	151,700	1,265,400	28.1
Reproduction	179,700	64,200	85,100	26,500	355,500	7.9
Clear cut	36,200	50,500	14,400	800	101,900	2.3
Total under sawlog size	788,800	423,600	331,400	179,000	1,722,800	38.3
Total all conditions	2,212,300	803,200	1,263,000	219,900	4,498,400	100.0
Percent of total	49.2	17.9	28.0	4.9	100.0	

[1] Includes shortleaf pine and pond pine types.

Longleaf pine dominates approximately 18 percent of the forest area. Although the most extensive areas of this type-group occur in the sand hills of Kershaw, Richland, and Chesterfield Counties, the best stands are in smaller, scattered tracts in Georgetown, Charleston, and Berkeley Counties. Loblolly pine, pond pine, and scrub oak are the most common associates, the latter frequently taking over areas of former longleaf pine land to the exclusion of commercially valuable species. This is particularly true in the sand hill section along the western boundary of the unit. The associated species together account for less than 20 percent of the total cubic volume in this type-group.

The remaining 33 percent of the forest acreage is occupied by various hardwood types. The bottomland hardwood type group commonly found in the flood plains of rivers and in the extensive areas of poorly drained swamp occupies 28 percent of the total forest area. The river bottoms are the source of most of the high-quality hardwoods cut in this unit. Red, black, and tupelo gum are the predominant species with oak, cypress, and loblolly pine the principal associates. A lower grade of oaks, gums, and hickories occurs frequently in the rolling uplands scattered among the pine stands. This upland hardwood type occupies an aggregate area of 220,000 acres, less than 5 percent of the total forest area, and includes about 87,000 acres of scrub oak which has completely taken over areas formerly occupied by longleaf pine.

The type map (fig. 1) indicates the general dominance of certain species or groups of species over extensive areas. Within these broad ranges many areas of different but less prevalent forest types occur, as well as large blocks of cultivated land. The acreage dominated by the major type groups as shown on the map, therefore, cannot be compared with area figures shown in table 2.

Forest Conditions

The forest area was classified according to its condition with respect to size, age, and cutting history of the timber (table 2). Sawtimber areas, on which sawlog-size trees predominate, occupy slightly more than 2-3/4 million acres, or 62 percent of the total productive forest area. This acreage of sawtimber was further classified into areas bearing stands of old-growth trees and areas bearing second-growth trees. The old-growth sawtimber area, nearly two-thirds of which is in the bottomland hardwood and cypress type group occuipes 19 percent of the total forest area. More than half of this, nearly 500,000 acres, has been culled for selected species and high quality trees. To consumers of high-quality timber the gradual depletion of the old-growth timber is probably the most significant change now taking place in the forests of the unit.

Second-growth stands predominate in the sawlog-size condition in all but the bottomland hardwood and cypress type-group. At the time of inventory almost two million acres were classified in this condition. Partial cuttings had occurred on 544,000 acres. Loblolly pine, with its principal associates -- longleaf pine, red gum, and pond pine -- make up 82 percent of the sawtimber volume in these forest conditions.

The under-sawlog-size condition contains three sub-divisions: (1) second growth, under-sawlog-size, (2) reproduction, and (3) clear-cut. The first of these is typical of areas where the predominant stand has advanced beyond the seedling stage but has not yet attained the size or volume necessary to produce sawlogs. Occupying slightly more than 1¼ million acres, this condition represents 28 percent of the forest area. The reproduction condition includes only those areas on which a new forest cover recently has become established. Occurring principally in the pine stands, this condition occupies only 8 percent of the forest area. The clear-cut condition, having less than 80 seedlings per acre, and insufficient volume or number of stems to qualify for any other forest condition, covers a total of [illegible],900 acres or 2 percent of the forest area. This is a relatively low proportion in comparison with other coastal survey units in the deep South particularly in Florida and Louisiana. The clear-cut area occurs as small tracts scattered throughout the unit. Nearly one half is in the longleaf pine type, chiefly in the sand hills.

A closer appraisal of forest conditions with regard to stocking and stand density discloses widespread deficiencies on much of the forest area. Probably the most outstanding of these deficiencies, because of its striking appearance rather than economic importance, is the 101,900 acres of forest land classified as clear-cut. Presenting problems of fire protection and perhaps direct planting in order to make them again reasonably productive, these clear-cut areas place upon their owners the financial burdens common to more productive forest lands without possessing the benefits of an immediate liquid asset or a growing resource.

In the large area of second growth many of the stands, particularly pine in the younger age-classes, are understocked. Heavy cutting and repeated fires have resulted in widely spaced stands with often an excessive number of poorly formed trees and inferior species. This condition is well illustrated by comparison of the average volume per acre (in cords) on uncut pine areas in representative age-classes, with average volumes weighted by site on the best 10 percent of the area in these types and age-classes.

Age class	Average volume per acre uncut conditions: All pine types	Average volume per acre uncut conditions: Best 10 percent of pine types	Relation all pine types to best 10 percent
	Cords	Cords	Percent
21-30	6.5	19.2	34
41-50	15.5	35.6	44
61-70	19.5	42.0	46

The fact that 10 percent of the pine area in these age-classes and conditions already supports such large stands is evidence that these densities of stocking are not unattainable objectives and further indicates the results that may be obtained through protective measures and reasonable management.

The rapid reduction of the old-growth acreage in the last 50 years has resulted in an unbalanced distribution of the forest area among the various size and age classes of timber. Instead of a desirable proportional distribution of acreage among all age classes, an excess has developed in the age-classes between 20 and 50 years, and a deficiency in the acreage of the more mature timber. Such a situation, although having little effect on the total volume of wood available each year, tends to place an increasingly high premium on old-growth timber and necessitates the readjustment or removal of a number of commercial forest enterprises.

Volume Estimates

Estimates of sawtimber volume include only merchantable trees containing timber of a size and quality suitable for sawlogs. The volumes are net log scale -- that is, allowance has been made for material that would be left in the woods because of rot, fire scar, crook, limbiness, and similar defects, as well as for loss in sawing at the mill due to sweep and interior defects.

Table 3. - Net board-foot volume classified by major species groups, according to International ¼-inch, Scribner, and Doyle log rules

Major species group	International[1] ¼-inch	Scribner	Doyle
	- - - - - - - - - Thousand	board feet	- - - - - - -
Pines			
Loblolly	6,322,400	5,494,000	3,934,100
Longleaf	1,341,000	1,114,200	697,500
Pond	545,700	467,000	316,200
Shortleaf	315,000	262,900	165,500
Total pines	8,524,100	7,338,100	5,113,300
Hardwoods			
Red gum	1,714,000	1,584,400	1,338,200
Black gum	1,074,400	987,400	771,800
Tupelo gum	429,300	396,200	326,100
Red oaks	620,000	573,500	489,700
White oaks	397,900	372,100	329,100
Ash	282,500	258,800	206,600
Others	883,400	797,700	629,600
Total hardwoods	5,401,500	4,970,100	4,091,100
Cypress	896,800	800,200	590,300
Total all species	14,822,400	13,108,400	9,794,700

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[1] The scale by International ¼-inch rule closely approximates green lumber tally.

The total net board-foot inventory is expressed in terms of three major log rules in table 3. Although the Doyle rule is used most commonly by the lumber industry, it is not a true measure of all standing timber throughout the wide range of tree diameters included in the inventory. The Scribner rule, now widely used by the United States Forest Service, although more accurate, likewise is faulty as a measure for mixed tree sizes. The closest approximation to actual recoverable volume for all-sized trees that may be computed through the use of log rules is that offered by the International ¼-inch log rule which is used in subsequent board foot tables in this report. Comparison of the Doyle and International estimates in table 3 discloses that the total volume according to Doyle rule is but 66 percent of that as measured by the International rule.

Of the 14.8 billion board feet inventoried in 1936, 58 percent was pine, 36 percent hardwoods, and 6 percent cypress (table 4). Loblolly pine is the predominant species in the unit, comprising 74 percent of the pine volume and 43 percent of the total sawtimber volume in all species. Among the hardwoods red gum is the leading species with a volume of nearly 1-3/4 billion board feet or 32 percent of all hardwood volume. With black and tupelo gum accounting for another 28 percent, the three gum species together make up about 60 percent of all the hardwood sawlog volume in the unit.

One-fourth of the pine volume and nearly three-fourths of the hardwood and cypress volume occur in the old-growth condition. This does not mean, however, that all of the volume in the old growth condition class is high quality material. Over half of the pine volume and over one-third of the hardwood and cypress volume in this condition occurs on "partly cut" areas indicating that these areas have been culled for selected species and high grade trees. In other instances, the old-growth consists of over mature stands or stands on poor sites which do not contain a high proportion of quality timber. The volume in old-growth conditions also includes the volume of second growth trees occurring on these areas. The old-growth pine is found chiefly in small scattered tracts throughout the central and eastern portions of the unit. Old growth hardwoods and cypress is confined to the bottomlands and swamps bordering the larger rivers, particularly the Santee, Wateree, and Pee Dee.

Practically all of the sawtimber volume shown in table 4 is accessible. The large bottomland swamps require special logging equipment but it is rare to encounter any physical obstacle to logging which modern machines and methods can not overcome. The more serious hindrances to harvesting timber are economic in nature and are closely associated with ownership and its policies, market conditions, stand quality and age, and stocking or stand density. A graphic analysis of the latter item may be considered an index to economic availability and is shown in figure 2 for the sawlog-size stands of the pine and hardwood type groups. In the former, the distribution of 8,370,300 M board feet on 1,803,100 acres is shown in volume-per-acre classes. Twenty-seven percent of the area in the pine type groups is occupied by stands with less than 2,000

Table 4. - Net board-foot volume classified by species group and forest condition

International ¼-inch rule

Species group	Forest condition					Total	Proportion of total
	Sawlog size				Under sawlog size[1]		
	Old growth		Second growth				
	Uncut	Partly cut	Uncut	Partly cut			
	- - - - - - - - -	Thousand board feet	- - - - - - - -				Percent
Pines							
Loblolly	726,100	715,300	3,723,100	966,500	191,400	6,322,400	42.7
Longleaf	53,800	279,000	741,200	160,200	106,800	1,341,000	9.0
Pond	121,200	83,000	243,100	67,500	30,900	545,700	3.7
Shortleaf	58,200	38,600	133,100	66,300	18,800	315,000	2.1
Total	959,300	1,115,900	4,840,500	1,260,500	347,900	8,524,100	57.5
Hardwoods							
Red gum	946,100	261,900	371,100	112,400	22,500	1,714,000	11.6
Black gum	399,700	412,200	187,300	56,000	19,200	1,074,400	7.3
Tupelo gum	202,300	189,400	27,400	6,600	3,600	429,300	2.9
Red oak	211,800	132,100	206,100	61,900	8,100	620,000	4.2
White oak	187,500	136,600	44,500	22,800	6,500	397,900	2.7
Ash	184,500	40,900	48,600	6,000	2,500	282,500	1.9
Others	311,200	235,000	254,300	60,900	22,000	883,400	5.9
Total	2,443,100	1,408,100	1,139,300	326,600	84,400	5,401,500	36.5
Cypress	466,900	204,400	171,400	39,300	14,800	896,800	6.0
Total all species	3,869,300	2,728,400	6,151,200	1,626,400	447,100	14,822,400	100.0
Percent of total	26.1	18.4	41.5	11.0	3.0	100.0	

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[1] Includes 64 million board-feet on the areas classified as reproduction and clear cut.

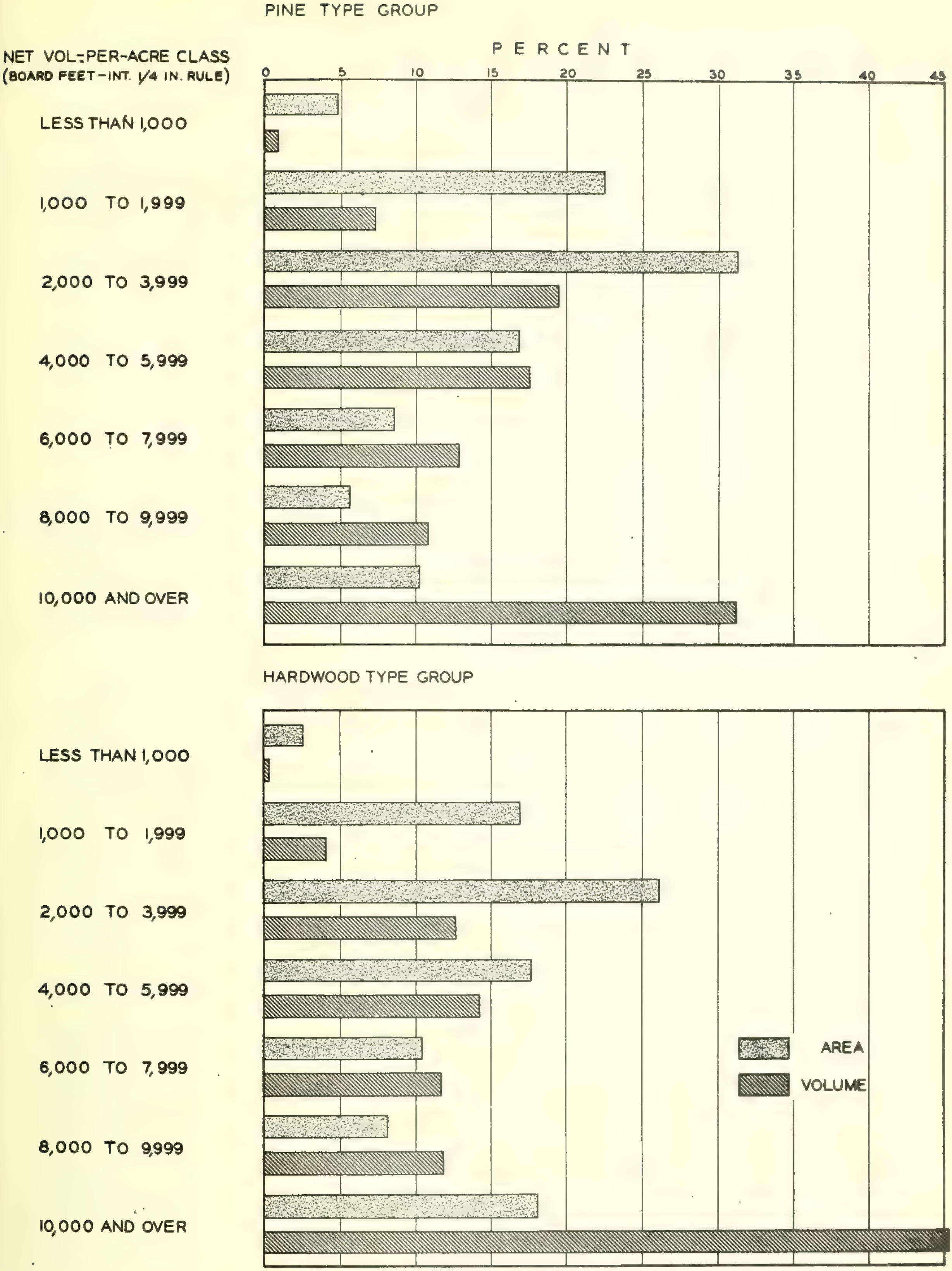

FIGURE 2.- PROPORTIONAL DISTRIBUTION OF AREA AND BOARD-FOOT VOLUME IN THE SAWLOG-SIZE CONDITIONS BY VOLUME-PER-ACRE CLASSES

board feet per acre and contains 8 percent of the volume. If a density of 2,000 board feet per acre is considered a minimum for profitable logging other factors being favorable, then nearly three-quarters of the sawtimber area carrying nine-tenths of the volume in these important type groups offers operating possibilities.

In the sawlog-size conditions of the hardwood type groups, which includes the cypress type, stands with less than 2,000 board feet per acre occur on less than 20 percent of the total sawtimber area in these conditions and type groups. Comparison of the heaviest stands of pine with hardwood shows that a substantially higher proportion of the hardwood sawtimber occurs in densities of 10 M or more board feet per acre than is true of the pine.

Table 5. - Average net sawtimber volume per acre classified by type group, species group, and forest condition

Type group and species groups	Forest condition				Average all sawlog size conditions	All under sawlog size conditions	Weighted average all conditions
	Sawlog size						
	Old growth		Second growth				
	Uncut	Partly cut	Uncut	Partly cut			
	Board feet per acre						
Pine type							
Species group							
Pine	10,030	5,040	4,330	2,750	4,260	260	2,660
Hardwood	1,230	540	330	280	380	20	230
Total	11,260	5,580	4,660	3,030	4,640	280	2,890
Hardwood type[1]							
Species group							
Pine	680	400	480	370	500	50	350
Hardwood	10,260	5,060	3,170	2,430	5,670	150	3,770
Total	10,940	5,460	3,650	2,800	6,170	200	4,120
Average all types							
Species group							
Pine	2,730	2,250	3,490	2,320	2,950	200	1,900
Hardwood	8,280	3,260	950	670	2,230	60	1,400
Total	11,010	5,510	4,440	2,990	5,180	260	3,300

[1] Includes cypress type.

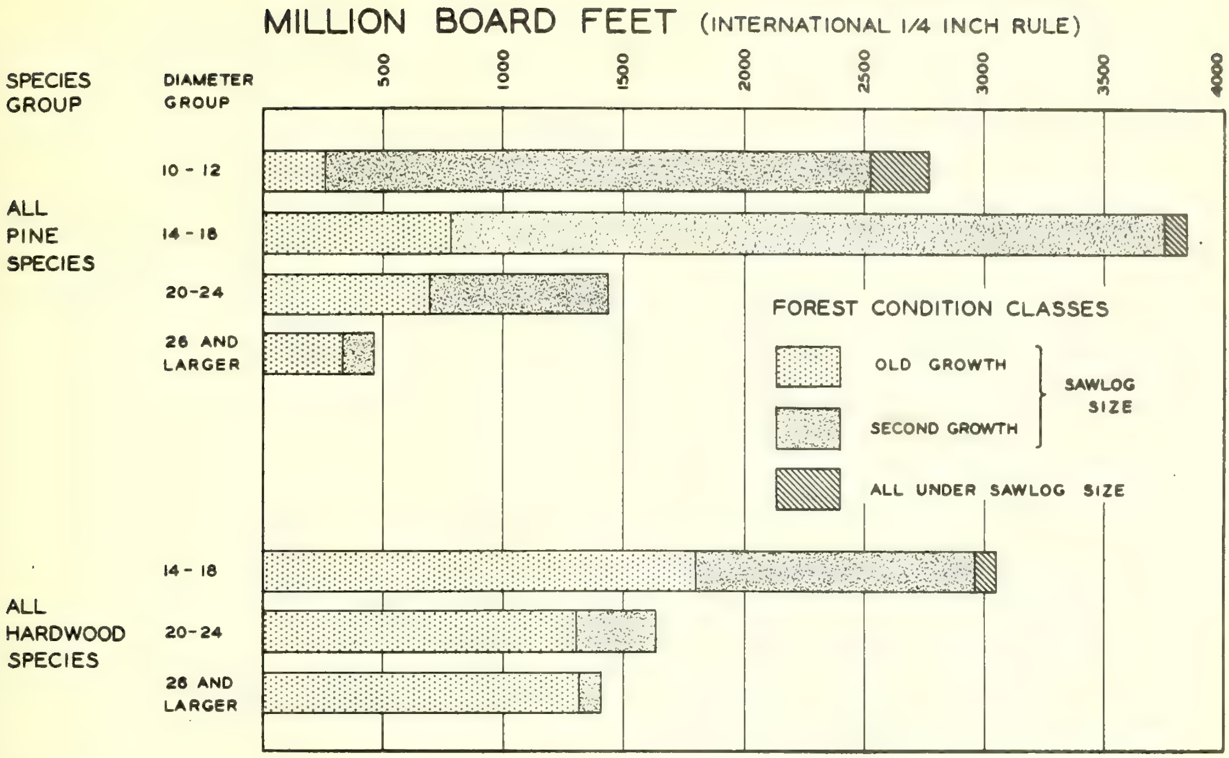

FIGURE 3.- DISTRIBUTION OF NET BOARD-FOOT VOLUME BY DIAMETER GROUP AND FOREST CONDITION

For purposes of comparison with similar forest conditions and species groups in other forested areas of the South, the data in table 5 are significant. Old-growth uncut pine in the pine type group averages more than 10 M board feet per acre, and the average for these species in all sawlog-size conditions is 4,260 board feet per acre. The volume of hardwoods in hardwood types ranges from 2,430 to 10,260 board feet per acre in the sawlog-size conditions, with an average of 5,670 board feet per acre for the four sawlog-size conditions. The average stand for all types together runs heavily to hardwoods in the old-growth conditions and heavier to pines in the second-growth conditions. The average for sawlog stands, regardless of type group or species, is 5,180 board feet per acre, and for the entire forest area 3,300 board feet per acre. These averages are larger than similar figures for any other coastal Survey unit in the South.[4]

Figure 3 illustrates a further classification of the total net board foot volume according to diameter groups and forest conditions. In the pine species the largest proportion of board foot volume in the 10 and 12-inch diameter classes is in the second-growth, sawlog size condition, although considerable volume in these tree sizes occurs in the old-growth and in the under-sawlog-size conditions. In the larger diameters, the volume derived from the under-sawlog-size conditions becomes negligible. In the 20 to 24-inch diameter classes the ratio between old-growth and second-growth is about even, and in the diameter groups 26 inches and over the old-growth condition is the leading source of all pine volume.

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[4] Forest Survey Releases 26 and 29, Southern Forest Experiment Station, New Orleans, La.

Among sawlog-size hardwoods, including a small volume of cypress, the 14 to 18-inch diameter groups are derived chiefly from the old-growth condition. The second-growth hardwood stands appear to be of less importance as an immediate source of sawtimber than the corresponding pine stands, particularly the diameter classes 20 inches and larger.

Cordwood Volumes

Table 6 shows the volume of all sound material expressed in standard cords.[5] These volumes are derived from the following sources:

1. The sawlog portion of sawtimber trees.

2. That portion of sawtimber trees not usable as sawlogs but acceptable as cordwood. This includes the upper stems of pines, and the upper stems and limbs of hardwoods and cypress to a minimum diameter limit of 4 inches outside bark.

3. The sound under-sawlog-size trees at least 5 inches d.b.h. in which the entire stem is included to a variable top diameter not less than 4 inches outside bark.

4. The estimated sound material in cull trees.

Deductions for cull include only the volume in defects which cause the material to be unsuited for cordwood. Sweep and slight crook are not regarded as defects.

Accessibility and economic availability of the cordwood volume depend upon many of the same factors that affect sawtimber, although the smaller average size of the trees and the lower quality permissible in marketing this class of material increases the quantity acceptable. The estimated volume in tops, approximately 11,820,000 cords, is available only as the trees are cut for lumber, cordwood or other use. A few companies use the tops following pulpwood or logging operations, but the practice is by no means general and only a small part of the volume in tops is utilized. The fact that 57 percent of the total cordwood volume occurs in the hardwood species indicates opportunities for more intensive use of these species. The large volume of cull black and tupelo gum is particularly significant as these species are becoming increasingly important as pulpwood and the cull material, occurring chiefly in pure stands in the "gum heads" is suitable only for this use.

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[5] Standard cord is equivalent to 128 cubic feet (4' x 4' x 8') of stacked bolts including bark.

Table 6. - Net cordwood volume classified by species group and source of material

Species group	Source of material				Total	Proportion of total
	Sawlog material	Tops of sawlog size trees1/	Under sawlog size trees	Cull trees		
	- - - - - -	- - - - - -	Cords	- - - - - -	- - - - - -	
Pines:						
Loblolly	13,855,600	2,538,400	2,811,300	385,100	19,590,400	26.3
Longleaf	3,133,100	747,400	1,475,400	61,600	5,417,500	7.3
Other pines	1,995,000	481,600	679,300	142,000	3,297,900	4.4
Total pines	18,983,700	3,767,400	4,966,000	588,700	28,305,800	38.0
Hardwoods:						
Red gum	3,897,800	2,376,800	2,069,700	799,300	9,143,600	12.3
Black gum	2,979,200	1,483,900	4,580,600	2,370,500	11,414,200	15.3
Tupelo gum	1,153,500	596,000	695,600	1,083,900	3,529,000	4.7
Oaks	2,619,200	1,413,700	1,774,900	2,791,900	8,599,700	11.5
Other hardwoods	2,909,400	1,580,600	3,070,200	2,613,000	10,173,200	13.6
Total hardwoods	13,559,100	7,451,000	12,191,000	9,658,600	42,859,700	57.4
Cypress:	2,096,700	601,200	396,400	316,100	3,410,400	4.6
Total all species	34,639,500	11,819,600	17,553,400	10,563,400	74,575,900	100.0
Percent of total	46.5	15.8	23.5	14.2	100.0	

1/ Includes the usable portion of the upper stems of pines and of the upper stems and limbs of hardwoods and cypress to a minimum diameter of 4 inches outside bark.

The total inventory is also shown in a condensed form in table 7 expressed in cubic feet.

Table 7. - Net cubic foot volume (inside bark) of all material classified by species group and source - 1936

Species group	Source of material				Total	Proportion of total
	Sawlog-size trees		Under saw-log size trees	Cull trees		
	Sawlog material	Tops[1]				
	- - - - - - - - -	Thousand	cubic feet	- - - - - - -		Percent
Pines	1,380,540	270,710	328,170	42,080	2,021,500	40.4
Hardwoods	919,650	443,550	776,140	592,500	2,731,840	54.6
Cypress	163,120	36,550	28,330	24,200	252,200	5.0
Total	2,463,310	750,810	1,132,640	658,780	5,005,540	100.0
Percent of total	49.2	15.0	22.6	13.2	100.0	

[1] Includes the usable portion of the upper stems of pines and of the upper stems and limbs of hardwoods and cypress to a minimum diameter limit of 4 inches outside bark.

Poles and Piles

A conservative estimate was made of the number of pine trees suitable for poles and piles. These premium trees occur as scattered individuals throughout the area but are most common in the uncut second-growth stands in the lower Coastal Plain counties. Of the 11,760,000 sticks (table 8), nearly three-fourths fell in the 20 and 25-foot length classes. Since many of these trees will be cut for lumber or pulpwood instead of poles, the table is chiefly significant as an indicator of the relative occurrence of poles by length and diameter classes in the pine stands of the unit.

Table 8. - Total number of pine poles and piles classified by length and diameter

Diameter class[1]	Length in feet						Total	Proportion of total
	20	25	30	35	40	45+		
Inches	- - - - - - - - -			Thousand sticks	- - - - - - - - -			Percent
7.0 - 8.9	2,568	520	96	--	--	--	3,184	27.1
9.0 - 10.9	2,121	854	433	286	--	--	3,694	31.4
11.0 - 12.9	979	796	568	318	125	32	2,818	24.0
13.0 - 14.9	148	510	427	193	77	86	1,441	12.2
15.0 - 16.9	--	141	190	83	38	55	507	4.3
17.0 - 18.9	--	13	55	19	10	19	116	1.0
Total	5,816	2,834	1,769	899	250	192	11,760	100.0
Percent of total	49.5	24.1	15.1	7.6	2.1	1.6	100.0	

[1] Diameter 4½ feet above ground, outside bark.

Forest Increment

Although the forest area has been described and classified as the Forest Survey found it in 1936 and its aggregate volume estimated as of January 1, 1937, these conditions must not be considered as static. Forest growing stock volume is an ever-changing quantity subject to the influences of a complex pattern of physical factors. Excluding the factor of cutting, the growth of individual merchantable trees in a stand and the additional volume recruited from young trees bring about a natural tendency toward increase in volume. Opposing these elements of increase, the factor of mortality constantly operates to remove volume, thereby reducing, or possibly entirely off-setting, any possible increase. The composite effect of these contrasting elements on stand volume over a given period is the net increment for that period. During 1936 the total growth that accrued to the forests of this unit, amounted to 786,300,000 board feet (table 12). Deducting the mortality of 130,500,000 board feet leaves a net increment, exclusive of commodity drain, of 655,800,000 board feet. Similarly, the cubic-foot growing stock has a gross growth of 180,360,000 cubic feet; mortality amounted to 40,270,000 cubic feet, leaving a net increase of 140,090,000 cubic feet (table 13).

The item of mortality is the volume lost annually through the death of trees as a result of overcrowding, fire, disease, insect attack, windthrow or other causes. In 1936 it amounted to approximately 17 percent of the gross board-foot growth and 22 percent of the gross cubic-foot growth. A substantial part of this loss is due to death through competition, and is a normal and desirable characteristic of stand development on forest properties not under intensive silvicultural management. Much of the loss, however, is due to unnatural causes, principally fire, which is particularly damaging to the seedlings and saplings and also takes a heavy annual toll of merchantable trees. As an indirect factor, fire damage is responsible for a considerable proportion of the losses directly chargeable to other causes, in that disease, insect attack, and windthrow frequently follow in severely burned stands.

While mortality cannot be eliminated, a substantial reduction in the loss can be realized through control of fire and through utilization of damaged and suppressed trees.

Table 9. - Average net increment per acre classified by forest condition and type of material - 1937

Forest condition	Sawlog-size material			All sound material	
	Pines	Hardwood	Total	Including bark	Excluding bark
	- - - - - Board feet	- - - - -	- - - - -	Cords - -	Cu. ft. -
Sawlog-size:					
Old growth					
Uncut	33	146	179	.37	25.7
Partly cut	46	89	135	.41	28.1
Second growth					
Uncut	204	44	248	.69	47.7
Partly cut	129	46	175	.51	35.3
Under sawlog-size:					
Second growth	68	8	76	.40	26.3
Reproduction and clear cut	8	1	9	.03	1.8
Weighted average all conditions	106	43	149	.46	31.6

An analysis of the net increment on a per-acre basis by forest conditions and broad species groups (table 9) affords a clearer picture of forest growth and serves as a basis for comparison with similar forest areas in the South. The weighted average board-foot increment per acre in this unit, 149 board feet, exceeds by a substantial margin comparable figures in other coastal plain Survey units in the South, the closest being 118 board feet per acre in southwest Alabama.[6]

Economic Aspects

The amount of industrial and domestic drain to which the forest is subjected each year is perhaps the best measure of the usefulness of this resource to the individuals and communities of the area. The magnitude of the industrial structure which the resource supports, the capital investment, employment, wages and profits, as well as more indirect benefits, establish the whole business of wood utilization as an important component in the economic life of the area.

Wood-using Industries

During the summer of 1937 a complete survey of the forest industries was made, to determine production in the calendar year 1936. This included the production of lumber, veneer, cooperage, pulpwood, and piece products, as well as the estimated amount of fuelwood cut for both commercial and domestic purposes.

The 267 sawmills operating during some portion of the year 1936 produced 410,500,000 board feet of lumber. Two hundred twenty-six, or 85 percent of these mills, were the portable type cutting from one to 10 M board feet per 10-hour day. These small mills cut 43 percent of the entire 1936 lumber production. Such mills generally operate in wood-lots and in tracts of timber where small private ownerships predominate. In this Survey unit there was concentration of small mills in Richland, Kershaw, and Chesterfield Counties, and a smaller group in the northeast section of Horry County (fig. 4). In the remaining counties, except those along the coast, there is a fairly uniform distribution of these mills. Where forest land is held in large tracts by lumber companies, pulp mills, game clubs, estates, or the Federal Government as in Charleston, Berkeley, and Georgetown Counties, there are few portable mills. The presence of large numbers of such mills in a region is a typical symptom of the stage reached in the exploitation of its forest resources, since they are commonly found where the available timber is too young, too widely scattered or too low in quality to be cut profitably by the larger mills. Moreover, a large number of small mills is evidence that the industry has passed through the era of large sawmills, and that an adjustment is being brought about which is gradually accommodating the methods of lumber manufacture to an altered form of resource material.

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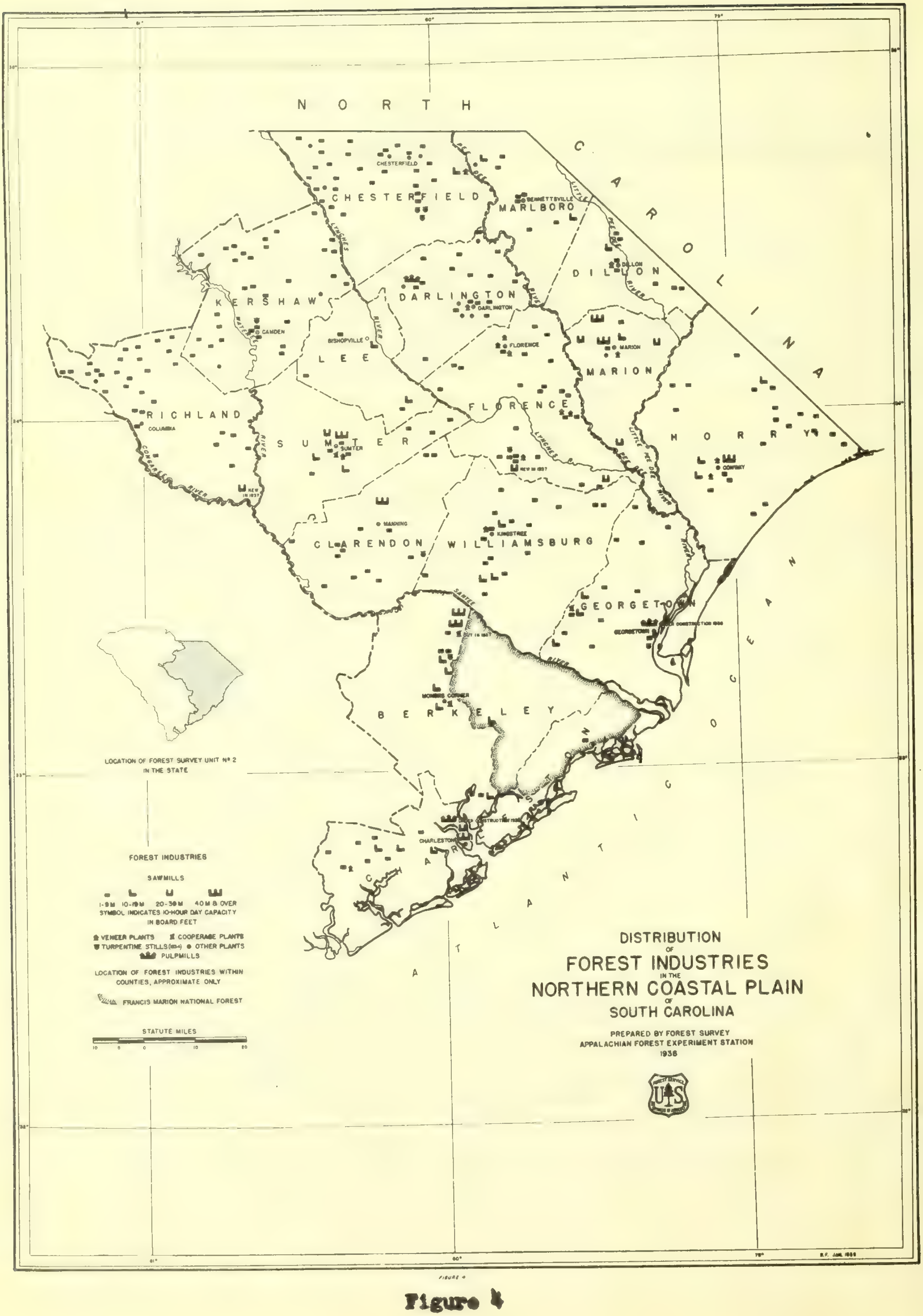
[6] Forest Survey release No. 35, Southern Forest Experiment Station.



DISTRIBUTION
OF
FOREST INDUSTRIES
IN THE
NORTHERN COASTAL PLAIN
OF
SOUTH CAROLINA

PREPARED BY FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1938

FIGURE 4

Figure 4

The 33 medium size mills, cutting 10 to 40 M board feet per day, accounted for 23 percent of the 1936 lumber production in this Survey Unit. There were only 8 mills cutting 40 M board feet or more per day, but they produced almost 34 percent of the total lumber cut. Thirty-four non-lumber plants scattered throughout the unit produced veneer, shingles, cooperage, furniture, and paper pulp. The production of fuelwood, crossties, and poles and piling rank high among the forest industries. The production of fuelwood alone, including wood for tobacco curing, constitutes a wood use second only to lumber in volume consumed. Approximately 60 percent of the fuelwood is cut from the stems of living sound trees, the remainder coming from cull and dead trees and from limbwood.

Table 10. - Production and employment in the primary wood-using industries - 1936

Commodity	Number of plants	Quantity produced	Employment		
			In woods	At plants	Total
			- - - Thousand man-days - - -		
		M bd. ft.			
Lumber	267	410,500	541	748	1,289
Veneer	15	76,900	145	298	443
Shingles	12	4,500	9	10	19
		Pieces			
Poles and piles	--	189 M	42	--	42
Crossties	--	292 M	41	--	41
		Cords			
Other commercial uses[1]	7	66 M	70	83	153
Fuelwood[2]	--	948 M	1,138	--	1,138
Domestic farm use[3]	--	39 M	43	--	43
Total			2,029	1,139	3,168

[1] Includes 4 cooperage plants, 2 furniture factories, and 1 pulp mill.

[2] Includes fuelwood for tobacco curing.

[3] Includes fence posts and other farm items exclusive of fuelwood.

The labor requirements of these industries totaled more than three million man-days in 1936 (table 10). Forty-one percent of the employment was provided by the lumber industry, 36 percent by the fuelwood industry, and the remaining 23 percent by the smaller commercial plants and domestic activities. On the basis of 250 working days per year, regular full-time employment was provided for more than 12,000 workers, but with many part-time employees particularly in the woods, the actual number receiving employment in the wood using industries was probably several times this number.

Naval Stores

At one time a major forest industry in this part of South Carolina, the naval stores industry has been reduced during the past few decades to one of comparatively minor importance. Only 8 turpentine stills were operating in 1936 (fig. 4). The activities of the stills and the 68 gum producers without stilling facilities provided about 50,000 man-days of employment. The supply of unworked or "round" timber available for Naval Stores operations is ample for present requirements, or for a moderate expansion, but the attitude of the timber owners, together with the general depressed condition of the turpentine and rosin markets, does not encourage new ventures in this field.

Commodity Drain

The total annual cut from the forest growing stock of the unit, regardless of destination or point of manufacture, together with the incidental woods waste, constitutes the commodity drain. Table 11 lists the total forest drain classified according to general species groups and commodity. For purposes of comparison the drain for all commodities derived from sawlog material is listed in board feet. Cubic foot measure is used to express the drain from all sizes of sound trees 5" in diameter and larger.

Table 11. - Commodity drain from sound trees - 1936

Commodity	Sawlog size material			All material		
	Pine	Hard-wood	Total	Pine	Hard-wood	Total
	Thousand board feet			Thousand cubic feet		
Lumber	303,100	103,300	406,400	55,340	16,470	71,810
Veneer	12,800	69,100	81,900	2,330	11,070	13,400
Shingles	2,600	1,900	4,500	480	290	770
Other commercial use	2,900	11,700	14,600	940	2,360	3,300
Poles and piles	16,800	--	16,800	3,060	--	3,060
Crossties	7,600	7,900	15,500	1,400	1,260	2,660
Fuelwood	61,500	28,300	89,800	24,700	15,250	39,950
Domestic farm use	3,900	1,100	5,000	2,060	580	2,640
Total	411,200	223,300	634,500	90,310	47,280	137,590

Lumber is the leading drain item, with fuelwood ranking second, veneer third. Approximately 47 percent of the total fuelwood drain came from sawtimber trees, in spite of the fact that there were standing in the forests of the unit a sound volume in cull trees of more than 10½ million cords. About 13 percent of the cubic foot drain was used in the manufacture of veneer, shingles, furniture, cooperage, and paper pulp. Another 4 percent went into poles, piles, and crossties.

The new pulp mills in Charleston and Georgetown were under construction in 1936 and their wood requirements were not included in the drain figures for this report. These two mills are reported to have a combined capacity in excess of 450,000 cords annually, and at capacity operation should provide about one million man-days of labor.

The Balance between Increment and Drain

Having described the forest, estimated its volume and increment, and determined its natural and commodity drain as of 1936, the foundation is laid for an analysis of these elements which show the status of the forest resources for that year. The net change in the amount of growing stock between January 1, 1936, and January 1, 1937, and the factors responsible for it are summarized in tables 12 and 13. In the sawtimber material (table 12) the hardwood growing stock was reduced by more than 32 million board feet. Sawlog-size pine growing stock, conversely, was increased by more than 53 million board feet, a volume sufficient to offset the reduction in the hardwood species and bring about a unit-wide increase of more than 21 million board feet.

Table 12. - Comparison between increment and commodity drain - sawtimber material

	Pine	Hardwood	Total
	- - - - Thousand	board feet	- - - -
Growing stock, January 1, 1936	8,470,500	6,330,600	14,801,100
Growth	531,700	254,600	786,300
Mortality	66,900	63,600	130,500
Forest increment	464,800	191,000	655,800
Commodity drain	411,200	223,300	634,500
Net change in growing stock, 1936	+53,600	-32,300	+21,300
Growing stock, January 1, 1937	8,524,100	6,298,300	14,822,400

The 21 million board foot surplus indicates a favorable balance for one year only - 1936 - and should not be construed as indicative of the existence of any positive trends in the supply of forest growing stock. Even though, for example, the hardwood growing stock was decreased and the pine growing stock increased in 1936, it does not follow that the same conditions existed in 1935 nor in 1937. Until a series of annual balances can be posted no definite indication of trends may be delineated. There are, however, a number of economic factors which had a significant bearing on the 1936 balance, and others will probably affect subsequent balance sheets.

Forest industries, particularly the lumber mills, although experiencing their best year since 1930, nevertheless operated below their 1920-1930 average. Many of the smaller mills operated only a few days during the year or not at all, so that the general demand on the forest resources was probably below that which might be expected during an active year. On the other hand, the effects of fire protection are already beginning to show in faster growth and better stocked stands. The effort at forest management and the application of silvicultural measures now being practiced by leading pulp and lumber companies, and by Government agencies should contribute during the next decade to a more favorable balance in the growing stock ledger, provided there is no great increase in wood consumption in the unit.

Of particular importance to the lumber industry is the progressive depletion of the old-growth timber. Analysis of the commodity drain and increment data indicates that these high quality stands, both pine and hardwood, are being cut much faster than they are growing. This situation is not brought out clearly in table 12 because the increment occurring on the younger stands of sawtimber is sufficient to offset the losses in the old-growth stands. Thus, although there is a distinct deterioration in the quality of the timber available, there can be no significant change in the total board foot inventory as long as the rapidly growing second growth can keep pace with the drain and offset the losses in the older age classes.

Although the hardwood sawtimber growing stock suffered a 32 million board foot reduction during 1936, the hardwood stands as a whole, including both sawtimber and the smaller cordwood material, were increased by a small volume. This is shown in table 13, expressed in cubic feet. The pine balance also shows a small increase and the net change in the entire forest growing stock during 1936 was an increase of more than 2½ million cubic feet.

Table 13. - Comparison between increment and commodity drain - all material

	Pine	Hardwood	Total
	- - - - Thousand cubic feet - - - -		
Growing stock, January 1, 1936	1,977,630	1,886,530	3,864,160
Growth	108,760	71,600	180,360
Mortality	16,660	23,610	40,270
Forest increment	92,100	47,990	140,090
Commodity drain	90,310	47,280	137,590
Net change in growing stock, 1936	1,790	710	2,500
Growing stock, January 1, 1937	1,979,420	1,887,240	3,866,660

Here again it should be pointed out that the small surplus in the pine volume does not justify too optimistic a viewpoint. The two new pulp mills, under construction during 1936, had not yet added their demands to the industrial drain from this area. These mills will probably draw one-half of their pulpwood from this unit. If one-half of their estimated combined capacity requirements had been drawn from the unit in 1936, the pine commodity drain would have been increased 17 percent. Instead of a surplus of more than 1-3/4 million cubic feet, as shown in table 13, there would have been a depletion of pine growing stock of about 14 million cubic feet.

Summary and Conclusions

The northern coastal plain of South Carolina is especially adapted to the continuous production of forest products. With nearly 60 percent of the land area forested, climate and soils that favor rapid tree growth, the presence of excellent diversified local markets for forest products, an adequate transportation system augmented by shipping facilities to northern centers, and a rural population available for employment in all types of forest industries, it is evident that the forests and forest industries will continue to rank as important factors in the general economy of this region.

Notwithstanding three centuries of indiscriminate timber cutting, land clearing, and until recently, little or no protection from fire, much of the present forest area is in remarkably good condition. At the time of the field survey 62 percent of the forest area was in the sawlog-size condition -- either second growth or old growth. Stands of 2,000 board feet or more per acre, which may be considered operable, occur on 47 percent of the forest area. The aggregate area classified as clear cut, where little or no stocking exists, amounts to only two percent of the total forest area, a comparatively low proportion with respect to other Forest Survey units in the South.

Despite the favorable situation these conditions appear to indicate, there are extensive areas where much improvement could be realized under more adequate fire protection and reasonable management. One-fourth of the area in the sawlog-size conditions has timber stands of less than 2,000 board feet per acre. The clear-cut area of almost 102,000 acres is producing practically nothing. Moreover, much of the area in both sawlog-size and under sawlog-size conditions is yielding but half the site capacity, and the presence of cull trees, inferior species, or worked-out turpentine trees materially lowers the value of the stands.

The comparison of growth and drain indicates that the forests as a whole, in their present condition, probably can support a demand equivalent to the 1936 requirements, which excludes the two pulp mills, without depleting the growing stock. Some adjustment would have to be made, however, in manufacturing methods and plant capacities to offset the declining volume of old-growth timber and to make efficient use of the smaller second-growth material. The small margin of increment over drain allows no provision for expansion of industry or for such exigencies as unusually bad fire years or insect epidemics, nor does it provide the surplus growth necessary to build up understocked stands. The requirements of the two new pulp mills alone will more than offset the surplus increment and result in a depletion of forest capital unless net growth can be increased sufficiently to offset this additional drain through a reduction in mortality and an increase in growing stock.

The forests of the unit are capable of producing adequate timber to meet these additional requirements and to allow for even further industrial expansion in future years, but concerted action will be necessary, on the part of both public and private agencies to attain this desirable objective. The primary step is to increase stocking through adequate fire protection and improved cutting practice designed to build up and maintain the forest in a reasonably productive condition.

Good progress has been made along these lines in recent years. The South Carolina State Commission of Forestry in cooperation with the U. S. Forest Service has established fire protection areas in all but two counties in this Survey Unit and the beneficial results are already evident. Including the acreage in the Francis Marion National Forest approximately 64 percent of the forested area is under organized protection. The Forest Management Division of the State Forestry Commission and the State Extension Service have been active in reforestation and have given advice to timberland owners regarding management of their holdings.

In the Francis Marion National Forest nearly 245,000 acres have been placed under a definite plan of management for the production of high quality sawtimber with intermediate cutting for pulpwood and other products. This area provides a large scale demonstration of the approved principles of timberland management.

The new pulp mills established on the coast have purchased large areas of forest land, over 200,000 acres in this unit, and have placed them under management to assure a continuous supply of pulpwood for their mills. Cutting rules to govern contractors working on company and other private lands have been adopted with a view toward integrated and complete utilization of their timber stands. Other forest owners, including lumber companies, estates and hunting clubs have initiated various forms of conservation measures on their properties.

These are encouraging indications that timber owners are beginning to realize the value of forest management. Much remains to be done, however. An extension of the educational program directed toward all forest land owners, particularly farmers, stressing fire protection and woodland management seems vitally necessary. The united efforts of public agencies with the cooperation of the industries and the forest land owners should, in a reasonable time, develop the forest resources of the unit to the point where they assume their full share of responsibility in the economic welfare of this region.

GLOSSARY

EXPLANATION OF TERMS

Forest survey unit. -- A subdivision of a state of from 6 to 10 million acres in which forest, topographic and economic conditions are reasonably homogeneous.

Non-productive forest area. -- Forest land that does not have the qualities necessary for the production of commercial timber.

Cropland. -- Land being used for the production of farm or orchard crops, or showing evidence of having been so used during the preceding 5 years, and still in such condition that it can be easily cultivated.

Abandoned cropland. -- Land formerly cultivated or pastured now showing distinct signs of having been abandoned for such use.

Improved pasture. -- Cleared or open land under fence, used primarily for grazing.

D.B.H. -- Diameter breast high. The diameter outside the bark of a tree measured at a point 4½ feet above the ground.

Diameter class. -- All trees were recorded in 2-inch diameter classes, that is, trees measuring 5.0 to 6.9 inches d.b.h. are in the 6-inch diameter class.

Merchantable tree. -- Any sound, well formed tree that is, or gives promise of becoming, a sawtimber tree.

Cull tree. -- One that, because of form, limbiness, rot, or similar defect, will not qualify as a merchantable tree.

Sawtimber tree. -- The following minimum requirements are necessary for hardwoods: 13.0 d.b.h., at least one sound butt log 12 feet long, or 50 percent of the gross volume of the tree in sound sawtimber material; for pine and cypress, at least 9.0 inches d.b.h., at least one sound butt log 12 feet long, or 50 percent of the gross volume of the tree in sound sawtimber material.

Under-sawlog-size tree. -- A merchantable pine or cypress measuring 5.0 to 8.9 inches d.b.h., a merchantable hardwood tree measuring 5.0 to 12.9 inches d.b.h.

Pole or pile tree. -- A pine tree from which a pole or pile could be cut conforming in general to specifications as set up by the American Standards Association.

Standard cord. -- A stacked pile of round or split wood bolts measuring 4' x 4' x 8' and estimated to contain 90 cubic feet of wood and bark in pine and cypress species, and 80 cubic feet of wood and bark in hardwood species.

Round timber. -- A stand of turpentine pine trees (longleaf or slash pine) that has not been worked or chipped for gum production.

Dominant and co-dominant trees. -- Trees which dominate and overtop the general surrounding stand.

Forest Type Groups

Loblolly pine. -- Stands in which pines make up 25 percent or more of the dominant and co-dominant stems with loblolly pine predominating.

Longleaf pine. -- Stands in which pines make up 25 percent or more of the dominant and co-dominant stems with longleaf pine predominating.

Bottomland hardwoods and cypress. -- Stands of mixed hardwoods, or hardwoods and cypress usually found in the larger river bottoms, which together make up 75 percent or more of the dominant and co-dominant stems.

Upland hardwoods. -- Stands of mixed oaks and other hardwoods occurring on the drier upland sites. Together these species make up 75 percent of the dominant and co-dominant trees. This type group includes a small area of scrub oak.

Forest Conditions

Sawlog Size

Old growth, uncut. -- Areas with stands composed predominantly of trees of sawtimber size having the characteristics of the original, mature timber of the region and containing at least 1,000 board feet per acre of merchantable hardwoods, or hardwoods and pine, in hardwood types. In pine types a minimum of 600 board feet per acre is required. Less than 10 percent of the volume has been cut.

Old growth, partly-cut. -- Areas with old growth stands from which 10 percent or more of the volume has been cut, leaving a minimum of 1,000 board feet per acre in the hardwood types, or 600 board feet per acre in the pine types.

Second growth, uncut. -- Areas with stands of second growth having at least 600 board feet per acre in trees of sawlog size, and with less than 10 percent of the sawtimber trees cut.

Second growth, partly-cut. -- Areas with stands of second growth in which 10 percent or more of the sawtimber trees have been cut but with the remaining stand containing 600 board feet per acre or more.

Under Sawlog Size

Second growth. -- Areas of young second growth in which the volume of timbe in trees of sawtimber size is less than 600 board feet per acre with the remainder of the stand under sawtimber size.

Reproduction. -- Areas not qualifying for any of the above conditions but which have at least 80 well established and well distributed seedlings and sprouts of commercial species per acre.

Clear-cut. -- Cut-over areas having insufficient young growth to qualify for second-growth or reproduction conditions.

FOREST SURVEY RELEASE NO. 2

SEPTEMBER 1, 1939

FOREST RESOURCES OF THE PIEDMONT REGION OF SOUTH CAROLINA

A progress report

by

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PREFACE

Through the McSweeny-McNary Forest Research Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the research branch of the United States Forest Service to carry out the provisions of the Act, and each regional forest experiment station was made responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station at Asheville, North Carolina.

The work of the Survey is divided into five major phases:

1. Inventory. The extent, location, and condition of forest lands, and the species, quantity, and quality of the timber on these lands.

2. Growth. The current and probable future productivity of forest areas.

3. Drain. The amount of timber cut for industrial and domestic use, and the loss from fire, insects, disease, suppression, and other causes.

4. Requirements. The present and probable future trend in the requirements for forest products by all classes of consumers.

5. Policies and Programs. Analysis of the relation of these findings to one another and to other economic factors as a basis in formulating public and private policies and programs of forest land use and management.

This progress report presents preliminary information on the first three of these phases for the Piedmont region (unit no. 3) of South Carolina, one of the three Forest Survey units into which the state has been divided. Similar releases have been prepared for the other two units, the Northern Coastal Plain and the Southern Coastal Plain. A report for the state as a whole will be published later.

Information on the forest resources of the Piedmont region was obtained through a field examination of sample plots during the fall of 1936. A total of 8,389 quarter-acre plots were established at intervals of one-eighth of a mile on compass lines 10 miles apart, extending across the unit from southwest to northeast. The data recorded for these sample plots were treated as a statistical sample of the entire unit. Consequently, small tabular items have a high probability of error and should be considered as indicating only relative magnitudes.

The figures on consumption of forest products for industrial and domestic purposes were obtained by canvassing all primary wood-using industries and a number of representative domestic consumers.

Acknowledgment is made to the Forest Survey staff of the Southern Forest Experiment Station for assistance in assembling the data for this release; and to the Regional Forester, Southern Region, U. S. Forest Service, and to Mr. H. A. Smith, State Forester of South Carolina, for review of the manuscript.

Additional copies of this report and copies of forthcoming releases may be obtained by writing to the Director, Appalachian Forest Experiment Station, Asheville, N. C.

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FOREST RESOURCES OF THE PIEDMONT REGION OF SOUTH CAROLINA

GENERAL ECONOMY OF THE REGION

The western third of South Carolina, comprising 18 counties, has been designated by the Forest Survey as the Piedmont unit (fig. 1). This unit covers 6,672,600 acres, and corresponds, as closely as county lines permit, with the Piedmont region of the state. It contains 42 percent of the state's agricultural land, 30 percent of the forest land, and 44 percent of the inhabitants.

The Piedmont unit of South Carolina is one of the more highly industrialized regions of the South. According to the 1935 Census of Business, 40 percent of the working personnel was engaged in manufacturing, 17 percent in business and professional activities, and only 43 percent in farming. In fact, nearly three-fourths of the workers engaged in manufacturing in the state were in this unit.[1]

Industrialization of the unit is largely a result of the development of the textile industry. Textile mills in 1935 contributed four-fifths of the total value of articles manufactured, and directly employed one-third of the unit's working personnel. All localities, however, are not industrialized, for textile mills are concentrated in the upper Piedmont, especially in Greenville, Spartanburg, and Anderson counties.[2]

In addition to textile manufacturing, farming and forest industries are the basic sources of employment. Farms, growing chiefly cotton, are, like textile mills, somewhat concentrated in the upper Piedmont, whereas forest industries are more numerous in the middle and lower Piedmont.[3] For the region as a whole, forest products are valued at much less than either textiles or cotton.

Land Use

Most of the Piedmont unit, except for the mountainous strip in the extreme western portion, is rolling upland. In general the soils and climate are favorable for growth of both forests and agricultural crops. Topographical features and soil conditions, such as the rough terrain of the mountains and soil depletion and erosion in sections of the lower Piedmont, largely determine the type of land use.

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[1] United States Department of Commerce, Personnel and Pay Roll in Industry and Business, and Farm Personnel, by Counties, 1937.

[2] South Carolina Department of Labor, First Annual Report, 1937, and United States Department of Commerce, Biennial Census of Manufactures: 1935, South Carolina.

[3] Three geographic divisions, in addition to the mountains in the northwestern edge of the unit, may be recognized -- the upper, middle, and lower Piedmont extending across the unit in a southwest-northeast direction.

Even though the Piedmont unit is now highly industrialized and heavily cultivated, 48 percent of the land is still in forests (table 1). Forests originally occupied practically all of the land, but by the time of the Civil War nearly half of the area had been cleared. Since that time agricultural land has been abandoned about as fast as new clearings have been made. Pine species usually became established on abandoned cropland through natural reforestation, with the result that most pine stands in the region are on land formerly cultivated.

Table 1. - Total land area classified by major use, 1936

Land use class[1]	Area		Proportion of total area	
	Acres		Percent	
Forest:				
Productive	3,187,200		47.8	
Nonproductive	15,900		0.2	
Total forest		3,203,100		48.0
Nonforest:				
Agricultural				
Cropland	2,754,400		41.2	
Pasture	204,400		3.1	
Abandoned cropland	245,800		3.7	
Towns, rights-of-way and miscellaneous uses	264,900		4.0	
Total nonforest		3,469,500		52.0
Total land area		6,672,600		100.0

[1] See glossary, page 29 for explanation of terms.

There are indications, however, that the cultivated acreage is now tending to decrease and the forest acreage to increase. The Forest Survey in 1936 found nearly 250,000 acres of former cropland definitely abandoned (table 1), but only a relatively small amount of recently cleared land. Furthermore, the harvested acreage of cotton, the principal crop of the region, was less in South Carolina in 1938 than during any year since 1878.[4]

Activities of several governmental agencies designed to bring about diversification of agriculture in the region are fostering local programs

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[4] Bureau of Agricultural Economics, Cotton Report as of December 1, 1938, Columbia, South Carolina.

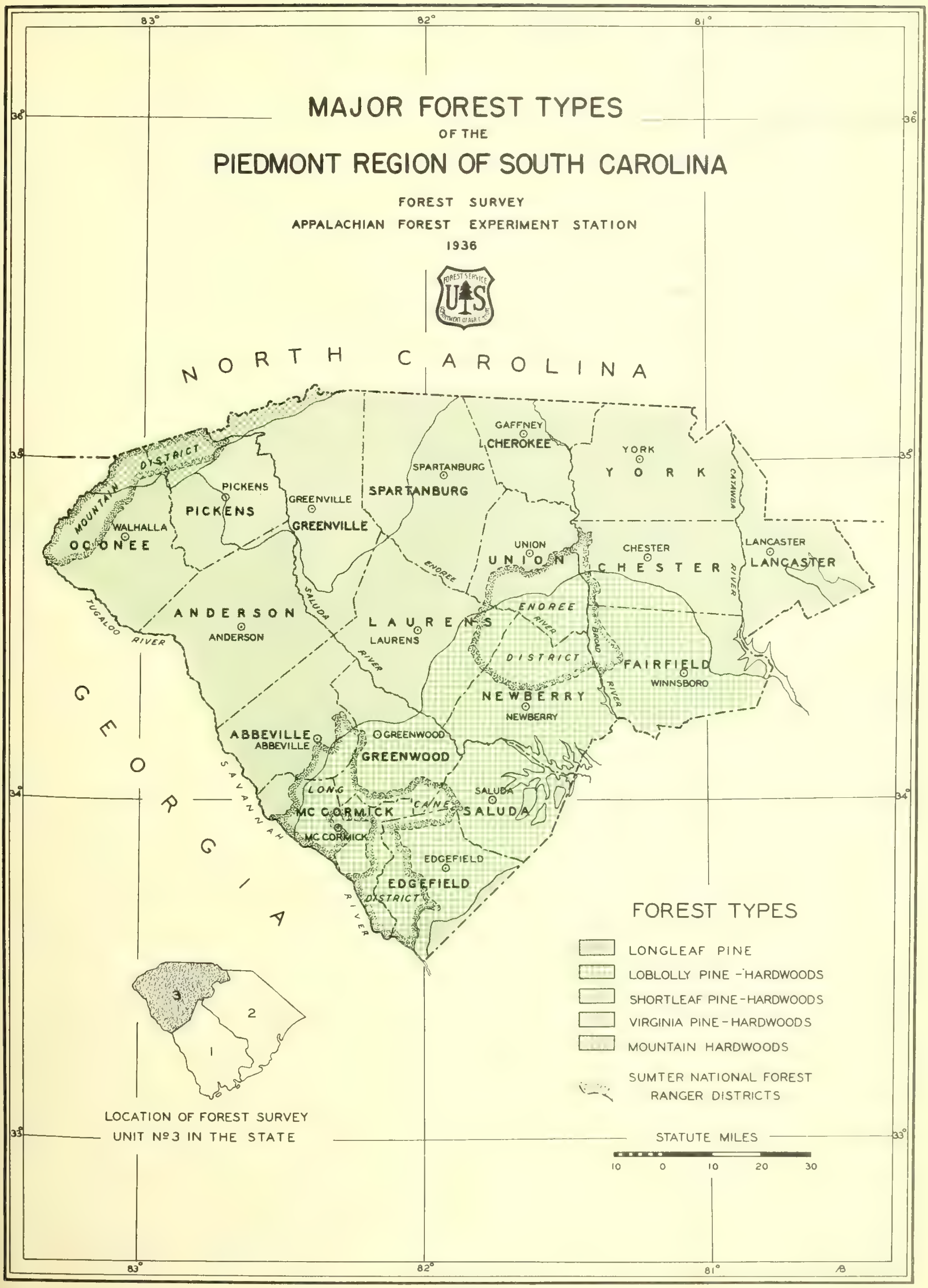
MAJOR FOREST TYPES
OF THE
PIEDMONT REGION OF SOUTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1936
83°
82°
81°
36°
35°
34°
33°
NORTH CAROLINA
GEORGIA
MOUNTAIN DISTRICT
OCONEE
WALHALLA
PICKENS
PICKENS
GREENVILLE
GREENVILLE
SPARTANBURG
SPARTANBURG
GAFFNEY
CHEROKEE
YORK
YORK
CATAWBA
LANCASTER
LANCASTER
CHESTER
CHESTER
RIVER
UNION
UNION
ENOREE
ANDERSON
ANDERSON
TUGALOO
RIVER
SALUDA
RIVER
LAURENS
LAURENS
ENOREE
RIVER
DISTRICT
BROAD
RIVER
FAIRFIELD
WINNSBORO
NEWBERRY
NEWBERRY
ABBEVILLE
ABBEVILLE
GREENWOOD
GREENWOOD
LONG
CANE
MC CORMICK
MC CORMICK
SALUDA
SALUDA
SAVANNAH
RIVER
EDGEFIELD
EDGEFIELD
DISTRICT
FOREST TYPES
LONGLEAF PINE
LOBLOLLY PINE - HARDWOODS
SHORTLEAF PINE - HARDWOODS
VIRGINIA PINE - HARDWOODS
MOUNTAIN HARDWOODS
SUMTER NATIONAL FOREST
RANGER DISTRICTS
3
2
1
LOCATION OF FOREST SURVEY
UNIT Nº3 IN THE STATE
STATUTE MILES
10
0
10
20
30
AB

FIGURE I.

of reforestation. The results are especially apparent through the increased area of woodland on farms whose owners are cooperating with the Soil Conservation Service. The Farm Security Administration is withdrawing submarginal areas from cultivation. Limitations by the Agricultural Adjustment Administration on the acreage of soil-depleting crops, especially cotton, as well as conservation payments for reforestation, are tending to increase the amount of forested land. The United States Forest Service, the South Carolina Forestry Commission, and the Agricultural Extension Service are also aiding individual landowners to recognize more clearly the returns to be expected from forest land with the result that many farmers are modifying their land use programs by planting trees or allowing unproductive agricultural land to reforest naturally. In addition, the submarginal farm land purchased by the United States within the boundaries of the three divisions of the Sumter National Forest (fig. 1) is being reforested.

The Erosion Problem

Past land use practices have resulted in a serious erosion problem throughout the Piedmont region of South Carolina. When cleared for cultivation, much of the land is particularly subject to erosion because of its rolling topography and friable soil, which alternately freezes and thaws during the winter months. Forty percent of the Forest Survey sample plots on cultivated land suffered from erosion, and on abandoned cropland, 68 percent of the plots were so affected.

Erosion was not restricted to the cropland of the unit. Of the forested sample plots 11 percent showed indications of sheet and shoestring erosion and another 6 percent were gullied. Such conditions were caused by removal of the forest cover without providing for adequate restocking to protect the soil from rapid run-off of surface water, and from abandonment of cultivated land on which subsequent natural reforestation had been too slow to overcome erosion. On the other hand, 9 percent of the forested plots gave evidence of recent erosion completely arrested by natural reforestation.

Erosion control on forest land in the unit, as well as on land removed from cultivation, requires the maintenance of an adequate vegetative cover to protect the soil. Since well-stocked forest stands usually afford the most practical means of providing this cover, the adoption of measures to promote reforestation will aid in solving the problem. In fact, one of the major returns to be expected from the forests of this region is in the conservation of its land and water resources.

Forest Ownership and Employment

Ownership of forest land is so distributed that forest and farming operations are closely interrelated. Two-thirds of the productive forest area is farm woodland, and provides at least part-time work for a major share of the 72,000 farmers living in the unit. Farm labor, furthermore, is extensively employed on the remaining one-third of the forest area.

On the Enoree, Long Cane, and Oconee divisions of the Sumter National Forest (fig. 1) special efforts have been made to provide forest work to supplement the income of economically depressed farmers. Although only one-fourth of the one million acres within the purchase boundaries of these divisions had been acquired by the United States by July 1, 1938, it has been demonstrated that through a planned program the forest resources of specific localities can provide a substantial part of the farm income -- a much more substantial part than is customarily received from farm woodland over the region as a whole.

Since less than 20 percent of forest land in the unit belongs to commercial and industrial firms, the forest resource will no doubt continue to be an asset primarily to farmers. The forest resource can furthermore become of steadily increasing value through development and proper use and eventually occupy an even more important place in the economy of both farm and industrial owners.

THE FOREST RESOURCE

Forest Area

Of the total forest land, 3,187,200 acres are productive and 15,900 acres are non-productive (table 1). The non-productive area appeared incapable of supporting merchantable trees, and is omitted from the description of the forest area. The productive forest area is classified by type, based on the predominating tree species, and by condition, based on board foot volume per acre, age of dominant trees, and cutting history.

Forest Types

Five broad forest type-groups have been recognized in the unit, shortleaf pine, loblolly pine, Virginia pine, upland hardwoods, and bottomland hardwoods (table 2). The chief commercial species, shortleaf and loblolly pines, predominate, respectively, on 56 percent and 22 percent of the forest area. The combined pine type-groups occupy approximately four-fifths of the productive forest land. In general, pine types are located on land formerly cultivated, and many of the trees have the limby appearance of "old-field" stands.

Although hardwood types are found on only 19 percent of the forest area, hardwood species form an important component of most pine types and make up 41 percent of the cubic foot volume of wood in the unit (table 7). Oaks, yellow poplar, and hickories predominate in the upland hardwood type group, occurring in small tracts throughout the Piedmont and in a rather solid block on the slopes of the mountains. The bottomland hardwood type-group, conversely, is confined to the level areas adjoining the major streams and is composed chiefly of red gum, yellow poplar, and oaks.

The various type-groups tend to dominate broad areas, as indicated on the map (fig. 1). Shortleaf and Virginia pine types predominate in the middle and upper Piedmont, whereas loblolly pine, with small tracts of longleaf pine, prevails in the lower Piedmont. Hardwood types occur throughout the unit, but are dominant only in the mountain section. Within these broad areas many different but less prevalent forest types occur, as well as extensive areas of cultivated land. The area dominated by the major type groups as shown on the map is therefore not comparable with the acreage figures given in table 2.

Forest Condition

The present condition of the timber stands with relation to age, volume per acre, and past cutting practice is indicated in table 2. Slightly over half of the forest area contains sufficient saw-timber

Table 2. - Productive forest area classified by forest condition and type group

Forest condition	Type group Shortleaf pine	 Loblolly pine	 Virginia pine	 Upland hardwoods	 Bottom-land hardwoods	Total	Proportion of total
	- - - - - - -	- - - - - - -	- - - Acres	- - - - - - -	- - - - - - -	- - - - - - -	Percent
Sawlog size:							
Old growth:							
Uncut	46,100	8,700	1,600	47,700	28,700	132,800	4.2
Partly cut	94,700	6,400	4,000	52,500	11,900	169,500	5.3
Total	140,800	15,100	5,600	100,200	40,600	302,300	9.5
Second growth:							
Uncut	423,900	177,400	27,000	58,900	50,100	737,300	23.1
Partly cut	367,500	145,500	16,700	55,700	16,700	602,100	18.9
Total	791,400	322,900	43,700	114,600	66,800	1,339,400	42.0
Total sawlog size	932,200	338,000	49,300	214,800	107,400	1,641,700	51.5
Under sawlog size:							
Second growth	770,700	324,500	52,500	160,700	89,900	1,398,300	43.9
Reproduction and clearcut[1]	76,400	43,000	9,600	9,500	8,700	147,200	4.6
Total under sawlog size	847,100	367,500	62,100	170,200	98,600	1,545,500	48.5
Total all conditions	1,779,300	705,500	111,400	385,000	206,000	3,187,200	100.0
Percent of total	55.8	22.1	3.5	12.1	6.5	100.0	

[1] Includes 4,800 acres classified as clearcut.

material to meet the requirements of the sawlog-size condition classes. Old-growth stands remain on less than 10 percent of the forest area, and over half of these areas have been culled for select species and high quality material. With the exception of a few large blocks in the mountains, the old-growth stands are in scattered small tracts.

The 42 percent of the forest area supporting second-growth sawlog-size stands is the condition class of greatest immediate interest as a source of raw material. Pine stands predominate, occupying 86 percent of the area.

Second-growth under-sawlog-size stands occupy 44 percent of the forest area, an unusually large proportion in comparison with the 28 and 33 percent, respectively, of the Northern and Southern Coastal Plain units in this condition class. Such stands contain an extremely important share of the future growing stock of the Piedmont region. But, since the trees are young, the area must be adequately protected from fire and efficiently managed to weed out inferior species and cull trees if it is to provide the supply of quality raw materials of which it is capable. The type of management given to these young stands during the next two decades will determine whether nearly half of the forest area will contribute its full share of raw materials to the economic progress of the region, or whether it will continue to be merely a partially developed resource.

Less than 5 percent of the forest area is classified under the reproduction and clearcut conditions. Areas classified as reproduction have sufficient seedlings or sprouts of commercial species eventually to develop into commercial stands. The clearcut area alone, estimated at only 4,800 acres, is small, indicating that natural reforestation is taking place on most cutover land.

The large percentage of the forest land in the under-sawlog-size conditions is attributed not only to extensive young stands developing on recently abandoned fields, but also to the general practice of cutting small diameter trees for lumber and other uses. This is particularly true in the more heavily cultivated sections of the unit. In general, pine species are even more heavily cut than hardwoods, and this may reduce the relative proportion of softwood material in future stands.

As a result of the wide-spread practice of cutting small trees, together with the failure of many areas to restock adequately through natural reforestation, stand density is generally low. The degree of understocking in the two major pine type groups is indicated by comparing the average cordwood volume per acre on uncut areas in representative age-classes with the respective average volumes weighted by site on the most heavily stocked 10 percent of the area in these type and age classes:

Average volume per acre for loblolly and shortleaf pine type groups, uncut conditions

Age-class	Entire area	Best 10 percent of area	Relation entire area to best 10 percent
Years	Cords	Cords	Percent
21 - 30	6.2	18.0	34
41 - 50	13.8	27.6	50
61 - 70	16.0	30.8	52

Although the best stocked 10 percent of these pine type groups does not represent the optimum stocking obtainable under intensive management, it does represent a degree of stocking obtainable for most of the forest area under reasonable protection and cutting practices.

Understocking in this unit is economically significant chiefly because of its effect on the quality and quantity of timber grown and the effectiveness of watershed protection provided. Thin stands, especially those of "old-field" origin, do not as a rule provide material of high quality and volume, nor adequately protect the soil from erosion.

Forest sites over the region as a whole are generally favorable for timber production even though many forest stands are on land that had been abandoned for agriculture. Timber production is dependent upon many factors, such as climate, soil, and topography, and the effect of these combined factors on the forest growth of a given area is measured by site indices. Pine site indices were 60 or better for two-thirds of the unit's pine-type area; i.e., dominant pine trees on these areas can be expected to reach a height of at least 60 feet in 50 years. Hardwood site indices, based on the form, height, and general appearance of the stands, were fair to good for four-fifths of the hardwood-type area; i.e., mature hardwood trees on these areas can be expected to have a merchantable length of 2 logs or more. Only one-fifth of the area in hardwood types, and one-third of the area in pine types, had poor site indices.

Timber Volumes

Volume estimates include the sound volume of all living trees 5.0 inches d.b.h. and over as of 1936. The sawlog portion of all trees suitable for sawtimber (softwoods 9.0 inches d.b.h. and larger and hardwoods 13.0 inches d.b.h. and larger) is expressed in board feet, and the entire volume of all trees is expressed in cords including bark, and in cubic feet excluding bark.

Sawtimber Volumes

The volume of sawtimber is shown by species in table 3, computed separately by the International ¼-inch, Scribner, and Doyle log rules. All volumes are net, that is deductions have been made for all volume losses caused by crook, limbiness, rot, butt wounds, and other defects. Although the Doyle and Scribner scales are more commonly used in the unit by the lumber industry, the International ¼-inch scale gives a more accurate measure of actual lumber production, and is used in subsequent board-foot tables in this report.

The net volume of sawtimber in the unit computed by International rule is nearly 6 billion board feet, 67 percent larger than by Doyle rule and 16 percent larger than by Scribner rule.

Table 3. - Net volume classified by major species group in International ¼-inch, Scribner, and Doyle log rules [1]

Major species group	International ¼-inch [2]	Scribner	Doyle
	Thousand ft. b.m.		
Softwoods:			
Loblolly pine [3]	1,327,000	1,124,600	750,600
Shortleaf pine	2,644,500	2,202,700	1,398,000
Virginia pine	168,800	140,200	84,500
White pine and hemlock	96,500	88,200	76,600
Total softwoods	4,236,800	3,555,700	2,309,700
Hardwoods:			
Red gum	309,600	279,900	220,000
Yellow poplar	448,400	410,800	341,900
Red oak	301,500	274,500	225,100
White oak	289,000	263,300	216,200
Hickory	140,100	128,900	99,300
Others	238,900	213,800	167,100
Total hardwoods	1,727,500	1,571,200	1,269,600
Total all species	5,964,300	5,126,900	3,579,300

[1] Excludes chestnut.

[2] The scale by International ¼-inch rule approximates green lumber tally.

[3] Includes small quantity of longleaf pine.

Table 4. - Net board foot volume classified by forest condition and species group (International $\frac{1}{4}$-inch rule)

Species group	Forest condition					Total	Proportion of total
	Sawlog size				Under sawlog size[1]		
	Old growth		Second growth				
	Uncut	Partly cut	Uncut	Partly cut			
	Thousand ft. b.m.						Percent
Softwoods:							
Loblolly pine	74,900	50,600	768,100	348,100	85,300	1,327,000	22.2
Shortleaf pine	280,800	345,000	1,141,200	710,200	167,300	2,644,500	44.4
Virginia pine	9,400	9,500	95,400	42,200	12,300	168,800	2.8
White pine and hemlock	71,000	14,200	9,500	1,600	200	96,500	1.6
Total softwoods	436,100	419,300	2,014,200	1,102,100	265,100	4,236,800	71.0
Hardwoods:							
Red gum	58,800	32,500	112,800	89,600	15,900	309,600	5.2
Yellow poplar	127,500	68,500	137,800	101,700	12,900	448,400	7.5
Red oak	65,900	67,800	84,800	67,600	15,400	301,500	5.0
White oak	73,400	82,100	71,200	46,400	15,900	289,000	4.9
Hickory	39,100	38,300	29,200	26,000	7,500	140,100	2.4
Others	45,700	24,000	107,500	45,800	15,900	238,900	4.0
Total hardwoods	410,400	313,200	543,300	377,100	83,500	1,727,500	29.0
Total all species	846,500	732,500	2,557,500	1,479,200	348,600	5,964,300	100.0
Percent of total	14.2	12.3	42.9	24.8	5.8	100.0	

[1] Includes 4.1 million board feet on the areas classified as reproduction and clearcut.

In table 4 a classification is made of board foot volume by species group and forest condition. Nearly half (44 percent) of the total volume is shortleaf pine, and almost one-fourth (22 percent) loblolly pine. All hardwoods combined make up 29 percent, red and white oaks, yellow poplar, and red gum being the principal species.

Old-growth stands contain 26 percent of the total board foot volume -- 20 percent of the pine volume, and 42 percent of the hardwood volume. This does not mean, however, that all of the volume in the old growth condition class is high quality material. Half is in partly cut

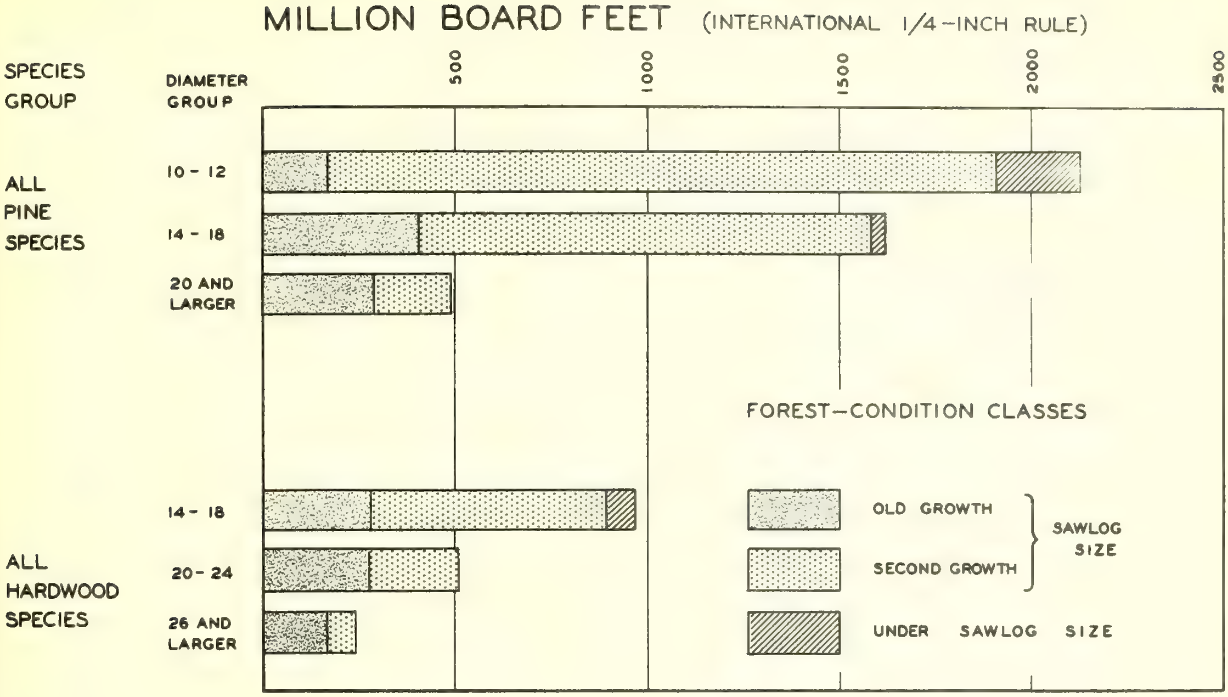

FIGURE 2.- DISTRIBUTION OF NET BOARD-FOOT VOLUME BY DIAMETER GROUP AND FOREST CONDITIONS

stands, previously culled over for the more valuable species and high grade trees, and a portion of the remainder is in either over-mature stands or stands on sites so poor that much of the timber is of low quality. Moreover, a considerable portion of the volume in old-growth stands is in trees of small diameter.

A classification of board-foot volume according to diameter groups and forest conditions is made in figure 2. This chart emphasizes the preponderance of small diameter trees, especially of pines, in all of the condition classes. Half of the total sawlog volume of softwoods is in trees of the 10- and 12-inch diameter classes, and nine-tenths in trees under 19.0 inches d.b.h. More than half of the hardwood volume is in trees under 19.0 inches.

Most of the sawtimber in the region is accessible. The general use of portable sawmills and the well developed transportation system of highways and railroads permits ready access to nearly all areas. Figure 3 showing the proportional distribution of area and board-foot volume for the sawlog stands indicates that stand density is usually sufficient for economic operation. Although one-third of the area in sawlog stands contains less than 2,000 board feet per acre, 86 percent of the volume of both hardwood and pine type groups is in stands of 2,000 board feet or more. Moreover, 32 percent of the volume in pine types, and 38 percent in hardwood types, is in stands of 6,000 board feet or more per acre, concentrated on 12 percent and 15 percent, respectively, of the area in these types.

In order to break down the sawtimber volumes into figures more easily comparable with those for similar forest conditions and species groups in other forested areas, table 5 has been prepared to show the average sawtimber volume per acre classified by type group, species group, and forest condition. The average volumes for sawlog-size condition classes range from 7,200 board feet for the uncut old-growth softwood types to 2,230 for the partly-cut, second-growth hardwood stands, with an average of 3,420 board feet for all sawlog stands. For the entire forest area, including both sawlog-size and under-sawlog-size stands, the average is 1,870 board feet per acre. These averages are lower than those in the Coastal Plain section of the state. The Northern Coastal Plain unit, for instance, has an average of 5,180 board feet per acre for sawlog stands, and 3,300 board feet for the entire forest area.

Table 5. - Average net sawtimber volume per acre classified by type group, species group, and forest condition

Type group and species group	Forest condition						
	Sawlog size					All under-sawlog-size conditions	Average all conditions
	Old growth		Second growth		Average all sawlog size conditions		
	Uncut	Partly cut	Uncut	Partly cut			
	Board feet per acre						
Softwood type group:							
Species:							
Softwoods	6,100	3,690	3,140	2,050	2 870	200	1,550
Hardwoods	1,110	1,110	430	440	520	30	280
Total	7,210	4,800	3,570	2,490	3,390	230	1,830
Hardwood type group:							
Species:							
Softwoods	1,200	490	390	260	570	70	350
Hardwoods	4,560	3,050	2,510	1,970	2 980	150	1,690
Total	5,760	3,540	2,900	2,230	3,550	220	2,040
All types:							
Species:							
Softwoods	3,280	2,470	2,730	1,830	2,420	170	1,330
Hardwoods	3,090	1,850	740	630	1,000	60	540
Total	6,370	4,320	3,470	2,460	3,420	230	1,870

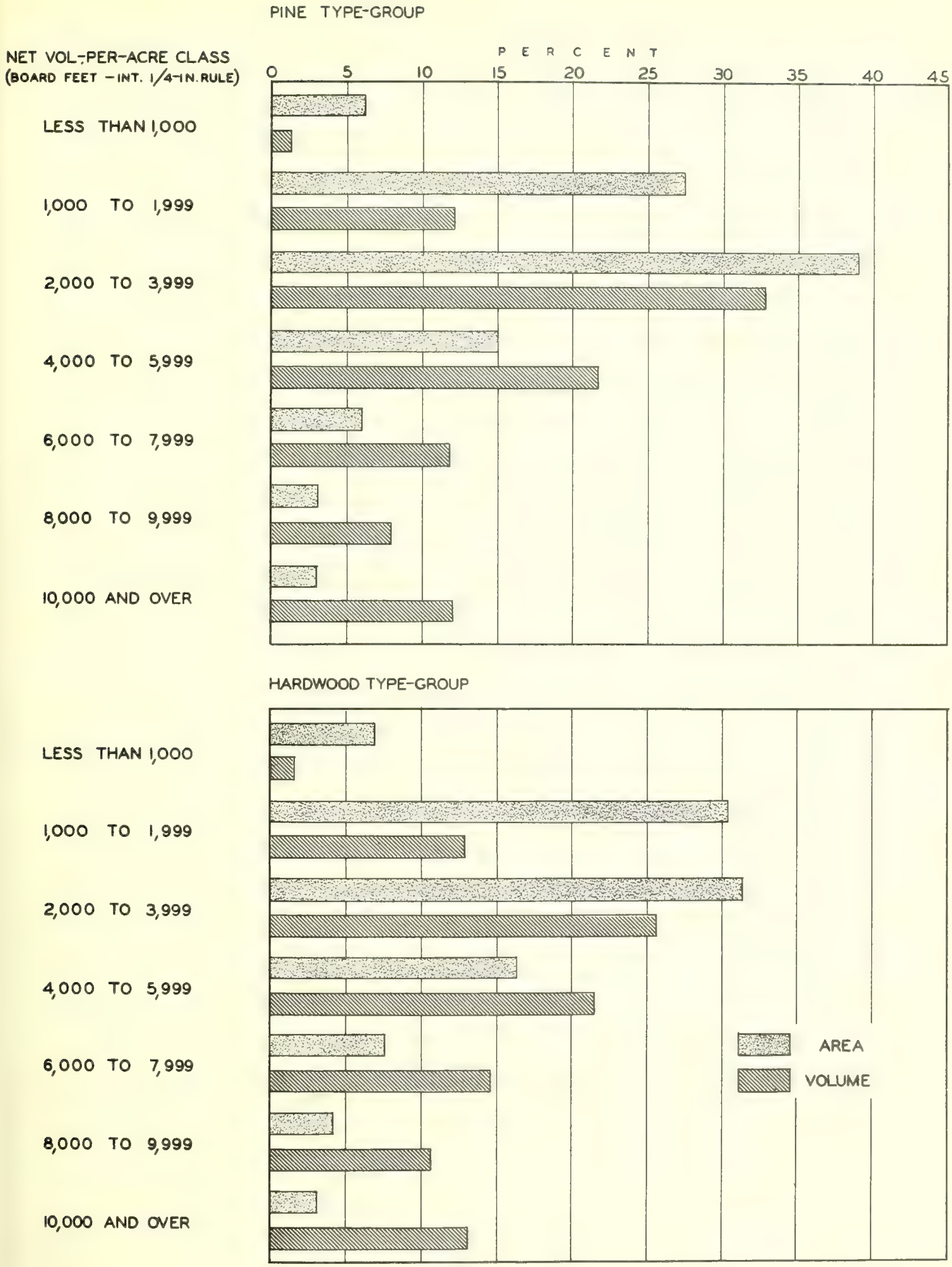

FIGURE 3.- PROPORTIONAL DISTRIBUTION OF AREA AND BOARD-FOOT VOLUME IN THE SAWLOG-SIZE CONDITIONS BY VOLUME-PER-ACRE CLASSES

Cordwood Volume

The total volume of wood in all living trees 5.0 inches d.b.h. and over amounted to nearly 37 million cords (table 6). Sawlog trees including tops are the source of 53 percent of the total volume, sound under-sawlog-size trees 35 percent, and cull trees 12 percent. The fact that softwood species make up only 56 percent of the cordwood volume, as against 71 percent of the sawtimber volume, is largely attributable to the lower diameter limit of softwood sawlog material.

Table 6. - Net cordwood volume classified by species group and source of material[1]

Species group	Source of material				Total	Proportion of total
	Sawlog material	Tops of sawlog size trees[2]	Under sawlog size trees	Cull trees		
	- - - - - -	- - - - - -	Cords[3]	- - - - - -	- - - - - -	Percent
Softwoods:						
Loblolly pine[4]	3,190,900	729,000	1,929,900	256,700	6,106,500	16.8
Shortleaf pine	6,762,200	1,118,600	4,735,800	530,500	13,147,100	36.0
Others	565,300	139,600	341,900	111,500	1,158,300	3.1
Total softwoods	10,518,400	1,987,200	7,007,600	898,700	20,411,900	55.9
Hardwoods:						
Red gum	767,400	418,300	992,600	276,000	2,454,300	6.7
Yellow poplar	1,069,900	615,600	662,700	232,000	2,580,200	7.0
Red oaks	780,600	405,300	926,500	552,200	2,664,600	7.3
White oaks	761,400	389,000	1,028,400	600,200	2,779,000	7.6
Others	993,900	514,800	2,243,300	1,881,800	5,633,800	15.5
Total hardwoods	4,373,200	2,343,000	5,853,500	3,542,200	16,111,900	44.1
Total all species	14,891,600	4,330,200	12,861,100	4,440,900	36,523,800	100.0
Percent of total volume	40.7	11.9	35.2	12.2	100.0	

[1] 86,800 cords of standing chestnut suitable for extract wood omitted.

[2] Includes the usable portion of the upper stems of softwoods and of th upper stems and limbs of hardwoods to a minimum diameter limit of 4 inches outside bark.

[3] Standard cord (4' x 4' x 8') including bark.

[4] Includes a small quantity of longleaf pine.

Effective utilization of the cordwood volume in hardwood cull trees is a major forest problem in the unit. Nearly one-fourth of the entire hardwood volume is cull material, amounting to four-fifths of the cordwood volume in all cull trees. Present cutting practices unfortunately tend to increase the percentage of cull trees, for as a rule only sound trees are cut.

Cubic-foot Volume

Table 7 shows the volume of solid wood inside bark in terms of cubic feet. This unit of measurement is well adapted to all products and to all parts of the tree, and provides the best basis for calculating net changes in total forest capital as a result of growth, mortality, and drain.

Table 7. - Net cubic foot volume (inside bark) of all material classified by species group and source, 1936

Species group	Source of material				Total	Proportion of total
	Sawlog size trees		Under saw-log size trees	Cull trees		
	Sawlog material	Tops[1/]				
	- - - - - - - - -	- -	Thousand cu. ft.	- - - - - - -	- - - -	Percent
Softwoods	736,590	167,720	470,590	63 310	1,438,210	58.6
Hardwoods	292,340	137,300	368,990	216,760	1 015,390	41.4
Total	1,028,930	305,020	839,580	280 070	2,453,600	100.0
Percent of total	42.0	12.4	34.2	11.4	100.0	

[1/] Includes the usable portion of the upper stems of pines and of the upper stems and limbs of hardwoods, to a minimum diameter limit of 4 inches outside bark.

Poles and Piles

Trees suitable for poles and piles bring a higher price when sold for this purpose than when utilized as sawlogs. For this reason an estimate has been made of the number of pine trees meeting the requirements for such use. Because many of these trees will be cut for lumber or other products, the information is valuable chiefly in showing the ratio between the number of sticks in the different diameter and length groups.

Only one-fifth of the 7.6 million pine trees (table 8) classified as suitable for poles and piles would make sticks 30 feet or longer, more than half being limited to 20-foot sticks.

Table 8. - Total number of pine poles and piles classified by length and diameter

Diameter class[1]	Length of stick in feet					Total	Proportion of total
	20	25	30	35	40+		
Inches	- - - - - - - - Thousand sticks					- - - - - - - -	Percent
7.0 - 8.9	2,457	741	168	--	--	3,366	44.4
9.0 - 10.9	1,164	675	350	93	47	2,329	30.8
11.0 - 12.9	392	419	351	149	41	1,352	17.9
13.0 - 14.9	63	121	170	106	24	484	6.4
15.0 - 16.9	--	6	16	11	2	35	0.5
Total	4,076	1,962	1,055	359	114	7,566	100.0
Percent of total	53.9	26.0	13.9	4.7	1.5	100.0	

[1] Diameter 4½ feet above ground, outside bark.

Forest Growth

Forest income from a long range point of view depends upon forest growth and increment as well as upon the timber volume standing at any one time. The term "forest growth" is used in this report to include the volume of wood accruing annually to merchantable trees, together with the volume of sound trees coming into the specified minimum diameter classes during the year.

The increment, or net volume of wood produced during any given year, is the volume of forest growth for that year less the volume loss through mortality from forest fires and from various natural causes such as tree competition, insect damage, disease, and windthrow. Increment thus represents the volume of sound wood available for cutting without depleting the forest capital.

In 1936 the total forest growth of the Piedmont unit was 151 million cubic feet (table 12). Mortality during that year amounted to 22 million cubic feet, a volume equal to 14 percent of total growth. The net increment for 1936 was therefore 129 million cubic feet, including 404 million board feet of sawtimber (table 13).

The average net increment per acre varies considerably among the different condition classes. During 1937, the latest year for which data on growth have been computed, the net increment varied from an average of 1.8 cubic feet (.03 cord) on the reproduction and clearcut condition to 58.1 cubic feet (.84 cord) on the second-growth sawlog-size condition (table 9). For the entire forest area, an average net increment per acre of 41.6 cubic feet (.61 cord), including 129 board feet of sawlog material, was realized. This may be compared with a per acre average of 31.6 cubic

Table 9. - Average net increment per acre classified by forest condition and type of material - 1937

Forest condition	Sawlog-size material			All sound material	
	Softwoods	Hardwoods	Total	Including bark	Excluding bark
	- - - - Board feet - - - -			Cords	Cu. ft.
Sawlog-size:					
Old growth:					
Uncut	55	60	115	.26	18.3
Partly cut	66	48	114	.39	26.9
Second growth:					
Uncut	197	44	241	.84	58.1
Partly cut	109	33	142	.60	40.8
Under sawlog-size:					
Second growth	67	13	80	.62	41.3
Reproduction and clear cut	8	2	10	.03	1.8
Weighted average all conditions	102	27	129	.61	41.6

feet, including 149 board feet, in the adjoining Northern Coastal Plain unit of the state.

The average increment per acre is simply an average by each condition without distinction between species and types and without considering the effect of cutting during the year. Such yields cannot be applied to any given locality, since the species distribution by condition is not likely to be similar to the average distribution for the region. Furthermore, net increment on specific areas not only depends upon the proportion of faster growing species, but also on site, stocking, age, and management. The figures do indicate, however, the average to be expected per acre from each condition for the region as a whole so long as no significant change occurs in species distribution or in other factors affecting growth and mortality.

FOREST RESOURCE UTILIZATION

The direct income from the forests of the region was chiefly from fuelwood and lumbering operations. Lumber was the principal commercial product, although a much greater volume of wood was cut for fuel. Indirect returns, particularly through soil and water conservation, were highly important, but for this study no attempt was made to determine their value.

Forest Industries

Lumber Industry

A total of 362 mills, mainly of the small portable type, were operated in the region during 1936 (table 10). Only two had a 10-hour day capacity of more than 10,000 board feet, and none more than 20,000 board feet (fig. 4). These mills cut 154 million board feet, an average of 425,000 board feet per mill for the entire year. Such a small average cut is a result not only of the limited capacity of the mills, but also of the fact that many were operated on a part-time basis. Even though small portable sawmills usually waste material, both in the woods and at the mill, and frequently produce poorly manufactured lumber, this type of mill will probably continue to dominate the local lumber industry because of the prevalence of farm woodland with young timber stands.

Fuelwood Industry

In terms of quantity of wood consumed, the greatest contribution of the forests of the unit during 1936 was fuelwood. A total of 1,237,000 cords was cut (table 10), about half from sound trees and the remainder from dead and cull trees and tops of trees cut for other purposes.

Fuelwood is more important as a subsistence crop than as a cash crop, for farmers produce and consume the major portion. Consumption in this unit, however, is considerably increased by the fuelwood requirements of the unusually large rural non-farm population of the small textile mill communities.

The active fuelwood demand provides an opportunity for utilizing the large amount of cull hardwood material. A larger part of the fuelwood should be cut from cull trees, thereby aiding in the development of more productive stands.

Miscellaneous Industries

During 1936 several minor industries were supported by the forest resources of the region. Many poles, piles, and crossties were cut, several shingle and dimension stock mills were operated, and a small amount of pulpwood was shipped. The total volume of wood used for such purposes, however, was small in comparison with the lumber and fuelwood production.

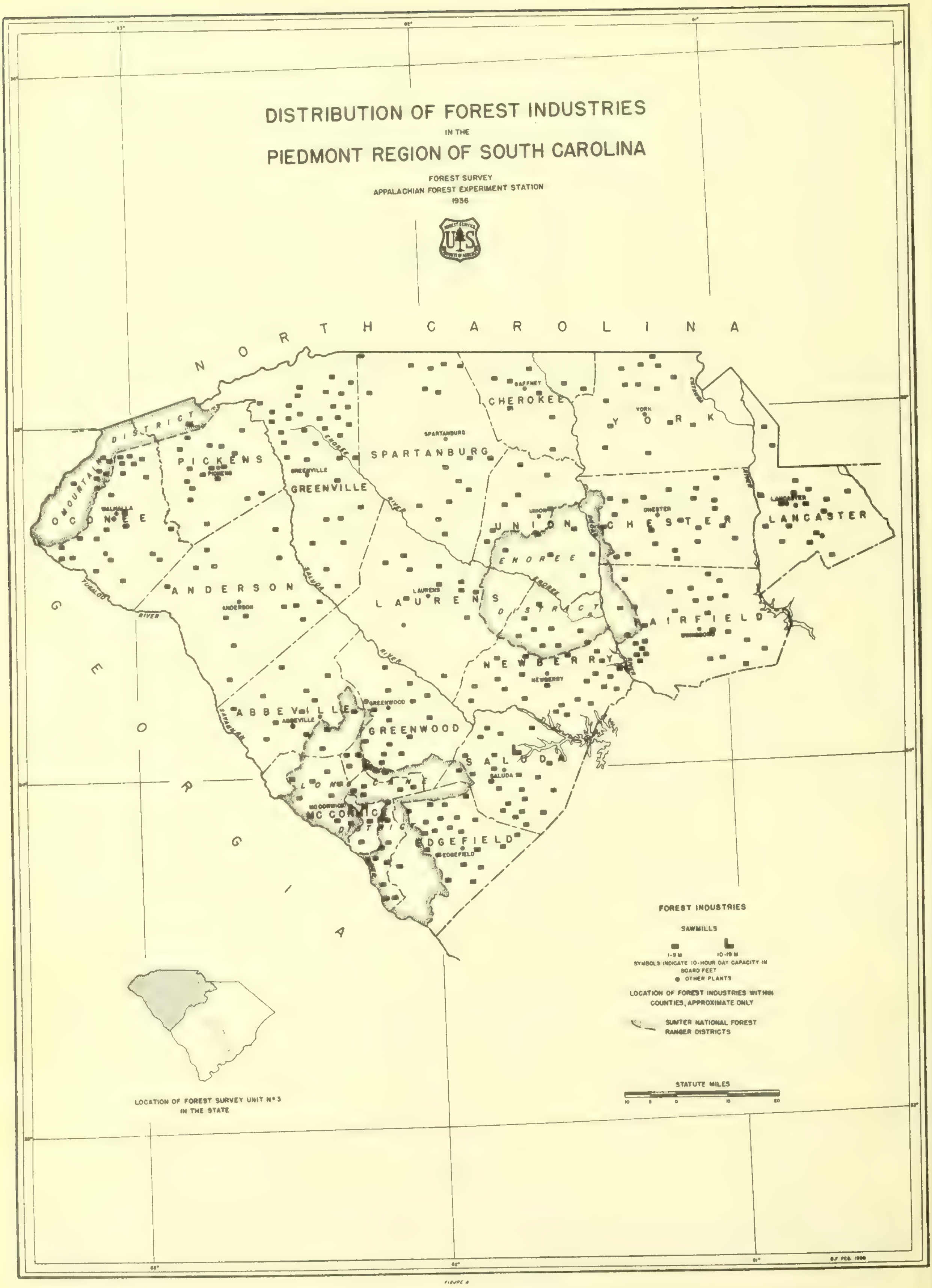
DISTRIBUTION OF FOREST INDUSTRIES
IN THE
PIEDMONT REGION OF SOUTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1936
NORTH CAROLINA
GEORGIA
MOUNTAIN DISTRICT
OCONEE
WALHALLA
PICKENS
PICKENS
GREENVILLE
GREENVILLE
SPARTANBURG
SPARTANBURG
CHEROKEE
GAFFNEY
YORK
YORK
CHESTER
CHESTER
LANCASTER
LANCASTER
UNION
UNION
ENOREE
ENOREE DISTRICT
ANDERSON
ANDERSON
LAURENS
LAURENS
FAIRFIELD
WINNSBORO
NEWBERRY
NEWBERRY
ABBEVILLE
ABBEVILLE
GREENWOOD
GREENWOOD
SALUDA
SALUDA
LONG CANE DISTRICT
MC CORMICK
MC CORMICK
EDGEFIELD
EDGEFIELD
TUGALOO RIVER
SAVANNAH
SALUDA
ENOREE RIVER
SALUDA RIVER
CATAWBA
BROAD
FOREST INDUSTRIES
SAWMILLS
1-9 M
10-19 M
SYMBOLS INDICATE 10-HOUR DAY CAPACITY IN BOARD FEET
● OTHER PLANTS
LOCATION OF FOREST INDUSTRIES WITHIN COUNTIES, APPROXIMATE ONLY
SUMTER NATIONAL FOREST RANGER DISTRICTS
STATUTE MILES
10
5
0
10
20
LOCATION OF FOREST SURVEY UNIT Nº 3 IN THE STATE
83°
82°
81°
35°
34°
33°
27 FEB. 1936
FIGURE 4

Figure 4

Table 10. - Production and employment in the primary wood-using industries, 1936

Commodity	Number of plants	Quantity produced	Employment		
			In woods	In mill	Total
		M ft. b.m.	- - - Thousand man-days - - -		
Lumber	362	154,000	179	240	419
		Pieces			
Poles and piles	-	45 M	10	-	10
Crossties	-	112 M	16	-	16
		Cords			
Other commercial uses	8[1]	25 M	27	1	28
Fuelwood	-	1,237 M	1,485	-	1,485
Domestic farm use[2]	-	47 M	51	-	51
Total			1,768	241	2,009

[1] Includes five shingle mills and three dimension stock mills.

[2] Includes fence posts and other items exclusive of fuelwood.

Employment

In 1936 slightly more than 2 million man-days of labor were provided by the forest industries (table 10). This is equivalent to full-time employment, based on 250 days per year, for 8,000 people. Actually, however, forest industries were of direct benefit to many more than 8,000 workers, for forest operations usually constitute only part-time employment.

Forest industries, as previously pointed out, are closely interrelated with farming activities. Probably half of the sawmills are operated by farmers on a part-time basis. Fuelwood production, which accounted for three-fourths of the total forest employment, is largely a part-time farm activity. Most of the farmers, representing 43 percent of the total workers of the unit, receive a portion of their income either through employment in primary wood-using industries or by cutting fuelwood for their own use.

Commodity Drain

Part of the wood cut in this unit during 1936 was obtained from sound trees, and part from dead and cull material. Since only sound trees constitute the growing stock, it is necessary to know the volume coming from them to determine the drain on the productive forest resource through utilization. Such drain or cut is termed "commodity drain".

Table 11. - Commodity drain from sound trees - 1936

Commodity	Sawlog-size material			All material			
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total	Percent of total
	- Thousand ft. b.m.[1]			- - Thousand cu. ft. (i.b.) - - -			
Lumber	147,300	5,500	152,800	31,510	940	32,450	38.6
Poles and piles	4,300	--	4,300	920	--	920	1.1
Crossties	1,200	5,900	7,100	260	1,020	1,280	1.5
Other commercial use	3,400	600	4,000	1,470	290	1,760	2.1
Fuelwood	63,900	37,300	101,200	26,430	18,110	44,540	52.9
Domestic farm use	4,600	1,400	6,000	2,510	700	3,210	3.8
Total	224,700	50,700	275,400	63,100	21,060	84,160	100.0

[1] Lumber tally.

Material cut from sawlog-size trees for all uses, including usable material left in the woods as waste, amounted in 1936 to 275 million board feet. The total commodity drain, from both sawlog-size and sound under-sawlog-size trees, was 84 million cubic feet (table 11). Approximately 39 percent of the cubic foot volume was used for lumber, 5 percent for other commercial products, and 56 percent for fuelwood and farm uses. Pine species supplied 97 percent of the lumber drain and 75 percent of the total commodity drain.

Increment Compared with Commodity Drain

In order to show whether the timber volume is being depleted or increased, forest increment is compared with commodity drain. Although 1936, the year for which the comparison is made, was in many respects a normal or average year, similar studies must be made at regular intervals to determine accurately any definite trend.

Table 12. - Comparison between increment and commodity drain - all material

	Softwoods	Hardwoods	Total
	- - - Thousand cu. ft. (i.b.) - - -		
Growing stock, January 1, 1936	1,344,130	646,930	1,991,060
Growth	109,230	41,700	150,930
Mortality	-15,360	-6,240	-21,600
Forest increment	93,870	35,460	129,330
Commodity drain	-63,100	-21,060	-84,160
Net change in growing stock, 1936	+30,770	+14,400	+45,170
Growing stock, January 1, 1937	1,374,900	661,330	2,036,230

During 1936 a volume equivalent to 67 percent of the cubic foot increment in sound softwood trees, and 59 percent in sound hardwoods, was cut. Consequently, the growing stock of the unit was increased by 30,770,000 cubic feet of softwood and 14,400,000 cubic feet of hardwood (table 12). The board foot volume of sawlog material also similarly increased (table 13).

Table 13. - Comparison between increment and commodity drain - sawtimber material

	Softwoods	Hardwoods	Total
	- - - - Thousand ft. b.m. - - - -		
Growing stock, January 1, 1936	4,143,000	1,692,400	5,835,400
Growth	355,100	100,000	455,100
Mortality	-36,600	-14,200	-50,800
Forest increment	318,500	85,800	404,300
Commodity drain	-224,700	-50,700	-275,400
Net increase in growing stock, 1936	+93,800	+35,100	+128,900
Growing stock, January 1, 1937	4,236,800	1,727,500	5,964,300

In view of the unit's deficiency in growing stock, the 1936 surplus of increment over commodity drain was distinctly favorable. Continued surpluses will gradually build up the growing stock in both volume and quality. The 1936 surplus, amounting to 35 percent of the increment, is in fact large enough to provide for some expansion in wood-using industries if market conditions warrant. Moderate expansion would partly meet the pressing immediate need for increased financial income in the unit and still provide for stand improvement. Any considerable reduction of the surplus in future years, however, will increase the time otherwise required to achieve reasonably adequate stocking over the forest area as a whole.

GENERAL FOREST SITUATION

Summary

Although the general economy of the Piedmont region is based largely on the textile industry and cotton production, forests and forest industries occupy an important place. Nearly half of the land area is still in forests, and forest industries provide part of the livelihood for a large portion of the rural population, especially farmers, who own two-thirds of the forest land.

The ratio between forest and cleared land has remained relatively stable since the Civil War. Much of the land, however, has passed through cycles of clearing and abandonment with the result that a large proportion of the present forest area is on land formerly cultivated. In recent years there has been a tendency toward an increase in forest land and a decrease in cultivated land -- an effect of both the general economic depression of agriculture and the conservation activities of public agencies.

Pine type groups predominate on four-fifths of the forest land. Pine stands are closely intermingled with cultivated areas, and, as a result of past land-use practices, often possess the limbiness characteristic of old-field forest growth. Hardwood types, predominant on only one-fifth of the forest area, are confined to the mountain slopes and small scattered areas throughout the Piedmont, but hardwood species are important associates in most pine stands. Forty-one percent of the cubic-foot volume in the unit is hardwood.

Timber stands in general are young. Nearly half of the forest area is in the under-sawlog-size condition classes, and less than one-tenth is in old growth. Half of the total pine sawtimber volume is in trees in the 10- and 12-inch diameter groups, and four-fifths of the volume of all species is in trees less than 19.0 inches in diameter.

Both the quality and quantity of timber on much of the area suffer from understocking. The average stocking on uncut shortleaf and loblolly stands, for instance, is less than half that on the best ten percent of these stands. Site indices, however, indicate favorable growing conditions over the area as a whole, with potentialities at present only partially realized.

Approximately 6 billion board feet of sawtimber was standing in 1936, nearly half of which was shortleaf pine and another quarter other pine species. Stands for sawlog-size conditions averaged 3,420 board feet per acre, and for the entire forest area, 1,870 board feet.

The total volume of all living trees 5.0 inches d.b.h. and larger was 37 million cords -- 56 percent softwoods and 44 percent hardwoods. Cull trees comprised 22 percent of the hardwood volume and 4 percent of the pine volume.

Increment for the unit as a whole is high in view of the understocked condition of the stands. The average per acre increment is .61 cords, including 129 board feet of sawlog-size material. At present, however, growth takes place to a large extent on stands of small diameter trees.

Lumber is the principal commercial forest product, but more wood is cut for fuel than for all other purposes combined. Lumber is manufactured chiefly by small portable mills, often operated in conjunction with farming.

Forest increment exceeded commodity drain in 1936 by a substantial margin, resulting in a surplus of 35 percent of the cubic foot increment. This is a favorable situation in view of the understocked condition of the forests.

Prospects

Declining markets for American cotton indicate that farmers in the Piedmont unit must look to other means of livelihood, a problem that forests and forest industries may partly solve. Particularly is this true in the "problem areas" where erosion and soil depletion are outstanding, for in such sections the forest resources often offer the most logical, if not the only, opportunity for new economic development. Even at present the forests of the region can support a somewhat heavier commodity drain and still leave a surplus sufficient to build up the growing stock and improve the quality of future material. Under forest management, moreover, the annual increment can be gradually increased so that a much greater supply of raw materials of a higher quality may eventually become available.

Local markets for cheap, low-grade lumber and fuelwood are being supplied by present production. Expansion of forest industries, therefore, appears limited to two possibilities. First is the opportunity of supplying high quality material to both local and national markets. Although present sawmills can readily expand production if market conditions become favorable, it will be a number of years before the region can produce a sufficient supply of high grade, large diameter trees to afford much active competition on the quality timber market.

A second opportunity is the development of a larger market for low-grade material. Since a large proportion of the timber volume in the unit is in species suitable for pulpwood, the current expansion of the pulp industry in the South appears to offer the most favorable immediate opportunity. Existing mills already draw small quantities of wood from the region, although they are too distant to provide a market for any large quantity of pulpwood. The unit, however, seems to offer an opportunity for the location of a medium sized pulp mill. Not only is an adequate supply of pulpwood available, with a large surplus of growth over drain, but labor and transportation facilities appear favorable.

A prospect for increased use of the forests of the unit is also in better watershed protection. Conservation of the soil and water resources, in view of the erosion problem and its severe effect on numerous hydroelectric developments in the region, is extremely important.

Facilitating measures

If the prospects for an increased income from forests are to be realized, a number of measures are necessary. A new market for low grade material must be developed, either through private initiative or through cooperation of private and governmental agencies. Improved methods of marketing the products of the many small forest owners are also desirable.

Better forest practices are needed on most areas to improve the quality and quantity of timber growth. These include planting abandoned fields, interplanting thin stands, thinning thick young stands, improvement cuttings to remove undesirable species and cull trees and reserve the better trees for future sawlog production, and improved fire control throughout the region. The large acreage of farm woodland offers a good opportunity for carrying out such measures, as labor is available during slack farming periods and the farm fuelwood requirements offer a use for small and cull trees.

Wider adoption of forest improvement measures depends directly upon the degree to which farmers are convinced that such measures are practical. This is a problem requiring cooperative efforts of governmental agencies with farmers. It involves educational work on a broader scale to inform farmers of the most desirable forest practices, research work to develop better forest practices and marketing procedure for the many small producers, and organized fire control throughout the unit, particularly in the 14 counties still without intensive protection in 1938.

GLOSSARY

General

Forest survey unit. -- An area of 5 to 10 million acres in which forest, topographic and economic conditions are reasonably homogeneous. The division of a state in this manner facilitates analysis and discussion of the forest situation.

Land-use Classes

Productive forest area. -- Forest land capable of producing timber of commercial quality.

Non-productive forest area. -- Forest land that does not have the qualities necessary for the production of commercial timber.

Cropland. -- Land being used for the production of farm or orchard crops, or showing evidence of having been so used during the preceding 5 years, and still in such condition that it can be easily cultivated.

Abandoned cropland. -- Land formerly cultivated or pastured and now showing distinct signs of having been abandoned for such use.

Pasture. -- Cleared or open land under fence, used primarily for grazing.

Forest Type Groups

Shortleaf pine. -- Stands in which pines make up 25 percent or more of the dominant and co-dominant stems with shortleaf pine predominating.

Loblolly pine. -- Stands in which pines make up 25 percent or more of the dominant and co-dominant stems with loblolly pine predominating.

Virginia pine. -- Stands in which pines make up 25 percent or more of the dominant and co-dominant stems with Virginia pine predominating.

Bottomland hardwoods. -- Stands in which hardwoods make up 75 percent or more of the dominant and co-dominant stems, usually found in river bottoms.

Upland hardwoods. -- Stands on the mountain and upland sites in which hardwoods make up 75 percent or more of the dominant and co-dominant stems.

Forest Conditions

Sawlog Size

Old growth, uncut. -- Areas with stands composed predominantly of trees of sawtimber size having the characteristics of the original, mature timber of the region and containing at least 1,000 board feet per acre of merchantable species in hardwood types, and 600 board feet per acre in pine types, with less than 10 percent of the volume cut.

Old growth, partly-cut. -- Areas with old growth stands from which 10 percent or more of the volume has been cut, leaving a minimum of 1,000 board feet per acre in the hardwood types, or 600 board feet per acre in the pine types.

Second growth, uncut. -- Areas with stands of second growth having at least 600 board feet per acre in trees of sawlog size, and with less than 10 percent of the sawtimber trees cut.

Second growth, partly-cut. -- Areas with stands of second growth in which 10 percent or more of the sawtimber trees have been cut but with the remaining stand containing 600 or more board feet per acre.

Under Sawlog Size

Second growth. -- Areas with young second growth stands in which the volume of timber in trees of sawtimber size is less than 600 board feet per acre with the remainder of the trees under sawtimber size.

Reproduction. -- Areas not qualifying for any of the above conditions but which have at least 80 well established and well distributed seedlings and sprouts of commercial species per acre.

Clear-cut. -- Cut-over areas having insufficient young growth to qualify for second-growth or reproduction conditions.

Diameters

D.b.h. -- Diameter breast high. The diameter outside the bark of a tree measured at a point 4½ feet above the ground.

Diameter classes. -- All trees were recorded in 2-inch diameter classes, that is, trees measuring 5.0 to 6.9 inches d.b.h. are in the 6-inch diameter class.

Tree Classification

Sawlog-size tree. -- A softwood tree at least 9.0 inches d.b.h., or a hardwood tree at least 13.0 inches d.b.h., with not less than one sound butt log 12 feet long, or with 50 percent of the gross volume of the tree in sound sawtimber.

Under sawlog-size tree. -- A sound softwood tree measuring 5.0 to 8.9 inches d.b.h., a sound hardwood tree measuring 5.0 to 12.9 inches d.b.h.

Cull tree. -- Any tree which, because of form, limbiness, rot, or other defect fails to qualify as a sawlog or under-sawlog-size tree.

Pole or pile tree. -- A pine tree from which a pole or pile could be cut conforming in general to specifications set up by the American Standards Association.

Volume Estimates

Cordwood volume. -- This volume (including bark) is derived from the following sources:

1. The sawlog portion of sawtimber trees.

2. That portion of sawtimber trees not usable as sawlogs but acceptable as cordwood. This includes the upper stems of softwoods, and the upper stems and limbs of hardwoods to a minimum diameter limit of 4 inches outside bark.

3. The sound under-sawlog-size trees at least 5 inches d.b.h. in which the entire stem is included to a variable top diameter not less than 4 inches outside bark.

4. The estimated sound material in cull trees.

Deductions for cull include only the volume in defects which cause the material to be unsuited for cordwood. Sweep and slight crook are not regarded as defects.

Standard cord. -- A stacked pile of round or split wood bolts measuring 4' x 4' x 8' and estimated to contain 90 cubic feet of wood and bark in softwood species, and 80 cubic feet of wood and bark in hardwood species.

Forest Growth

Cubic foot. -- The volume inside bark accruing to all sound trees 5.0 inches d.b.h. and larger, plus the volume in sound trees reaching this specified minimum diameter during the period for which growth is computed.

Board foot. -- The volume accruing to sound softwood trees 9.0 inches d.b.h. and over and hardwood trees 13.0 inches and over, plus the volume in sound trees reaching these respective diameters.

FOREST SURVEY RELEASE NO. 3 DECEMBER 1, 1939

FOREST RESOURCES OF THE SOUTHERN COASTAL PLAIN OF SOUTH CAROLINA

A progress report

by

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U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

Appalachian Forest Experiment Station
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FOREWORD

The field work and computations for this report were done under the direction of the Forest Survey staff of the Southern Forest Experiment Station, New Orleans, Louisiana. J. W. Cruikshank supervised the field work and P. R. Wheeler was in charge of the computations. A. R. Spillers assembled the data and drafted the original manuscript. Additions and revisions have been made by the Survey Staff of the Appalachian Forest Experiment Station.

Information covering several phases of the forest situation in this unit has been issued by the Southern Forest Experiment Station in the following advance releases, which may be obtained by writing the Director, Southern Forest Experiment Station, New Orleans, Louisiana:

Forest Survey Releases

No. 10 - Advance Information on the Supply of Pulpwood in Survey Unit No. 1. South Carolina.

No. 14 - The Quantity and Status of Naval-Stores Timber in Survey Unit No. 1. South Carolina.

No. 17 - Statistics on Gum Naval Stores Production.

No. 20 - Longleaf Pine Stumpwood Supply in Four Southeastern Survey Units.

No. 21 - Pole and Pile Timber in Four Southeastern Survey Units.

No. 25 - Sawmills in the Lower South.

No. 29 - Volumes on Average Acres in the Principal Units of the Naval-Stores Region.

PREFACE

Through the McSweeny-McNary Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act, and each of the 12 Regional Experiment Stations was made responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station, Asheville, North Carolina.

The work of the Survey is divided into 5 major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of the timber on these lands.

2. Growth. Determination of the current rate of timber growth.

3. Drain. Determination of the amount of industrial and domestic wood use, and the total loss resulting from fire, insects, disease, suppression, and other causes.

4. Requirements. Determination of the current and probable future requirements for forest products by all classes of consumers.

5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis for public and private policies and plans of forest land use and management.

This progress report presents preliminary information on the first three of these phases for the Southern Coastal Plain of South Carolina, one of the 3 units into which the state was divided. Similar releases have been published for the other units, the Northern Coastal Plain, and the Piedmont Region, and may be had upon request. A final report for the state is being prepared for publication.

Information on the physical forest resources was obtained by a field survey made in the summer of 1934. A total of 6,400 sample plots were established at intervals of one-eighth of a mile on compass lines 10 miles apart, extending across the unit from east to west. The statistical sample obtained from these plot records forms the basis for all area and volume estimates in this report, except where other sources are directly credited. Owing to the method of sampling data, small tabular items have the greater probability of error and should be considered as indicating relative magnitude rather than actual values.

Data on consumption of forest products for industrial and domestic purposes were obtained by canvassing all primary manufacturing plants and a number of representative domestic consumers.

FOREST SURVEY STAFF
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FOREST RESOURCES OF THE SOUTHERN COASTAL PLAIN OF SOUTH CAROLINA

GENERAL DESCRIPTION

The Southern Coastal Plain Unit (Forest Survey Unit No. 1) consists of 12 counties in the southern part of the state (fig. 1) with a total land area of more than 5 million acres. From a forestry viewpoint it is distinguished from the other sections of the state by the presence of extensive areas of longleaf and slash pine which support an active naval stores industry. In this respect it resembles more closely the coastal regions of the deep South than the other coastal units in South and North Carolina.

The physical characteristics of the area are typical of the Southeastern Coastal Plain. Along the coast sandy beaches or treeless marshes intersected by meandering streams gradually merge into level flatwoods which form a narrow, irregular belt extending across the entire unit from north to south. Farther inland elevations gradually increase and the land surface becomes rolling. The maximum elevation of approximately 650 feet is reached in the rolling sand hills of Lexington and Aiken Counties which mark the junction of the coastal plain and piedmont regions. Drainage is southeasterly through the Santee, Savannah, Combahee, and Edisto rivers and their tributaries. Soil conditions, gradient, and ground cover are such that destructive erosion is not a serious problem in this area. Although sheet erosion is more or less prevalent on open land, particularly in the central and western sections, deep gullying is rare. The heavy silt load of the larger rivers comes principally from the fields and caving banks in the Piedmont Plateau.

Harbor facilities for handling both coastwise and transatlantic trade are available at Charleston and Savannah. The Intracoastal Waterway and the navigable channels of the Savannah, Combahee, Edisto, and Santee rivers are open to small power craft, barges, and rafts. The Southern, Atlantic Coast Line, Seaboard Air Line, Charleston and Western Carolina, and a number of smaller railroads, together with an excellent highway and county road sys tem, provide overland routes of transportation.

The 1930 Census lists the population in the unit as 312,000; 60 percent living on farms, 32 percent in small communities, and only 8 percent in towns having a population over 2,500. There are no large cities in the unit, although Charleston and Columbia, South Carolina, and Savannah and Augusta, Georgia, are in adjoining counties and have a marked influence on the general economy of the area.

Approximately 70 percent of the working personnel in the area, according to the 1935 Census of Business was engaged in farming, and the remaining 30 percent was about equally divided between manufacturing and various types of business and merchandising. More than half of the employees engaged in manufacturing were located in Lexington and Aiken Counties where the textile industry had been developed extensively. Outside of these two counties, the principal manufacturing activities are lumbering and production of naval stores. Because of the integration of farming with the manufacture of forest products, many farmers are dependent on forests, particularly on the part-time jobs supplied by the naval stores and lumber industries. The Census of Unemployment,[1] taken in 1937, listed a total of 30,929 individuals who were totally unemployed, partially employed, or working with some emergency relief organization. This group is 20 percent of the total for the entire state. Of the number listed in these three classifications, approximately one-half were farm residents.

The Forest Survey found that in 1934, 58 percent of the entire area was in forests,[2] 32 percent in cropland and pasture, 4 percent in abandoned cropland and the remaining 6 percent in treeless tidal marshes, towns, rights-of-way and other non-forest classifications (table 1).

Table 1. - Total land area classified by major use[1]

Land use class	Area		Proportion of total area	
		Acres		Percent
Forest		2,993,000		57.7
Non-forest:				
Agricultural:				
Cropland	1,645,100		31.7	
Pasture	31,400		.6	
Abandoned cropland	181,600		3.5	
Marsh	212,200		4.1	
Towns, rights-of-way, etc.	123,600		2.4	
Total non-forest		2,193,900		42.3
Total		5,186,900		100.0

[1] Does not include 91,200 acres in the coastal islands of Beaufort County.

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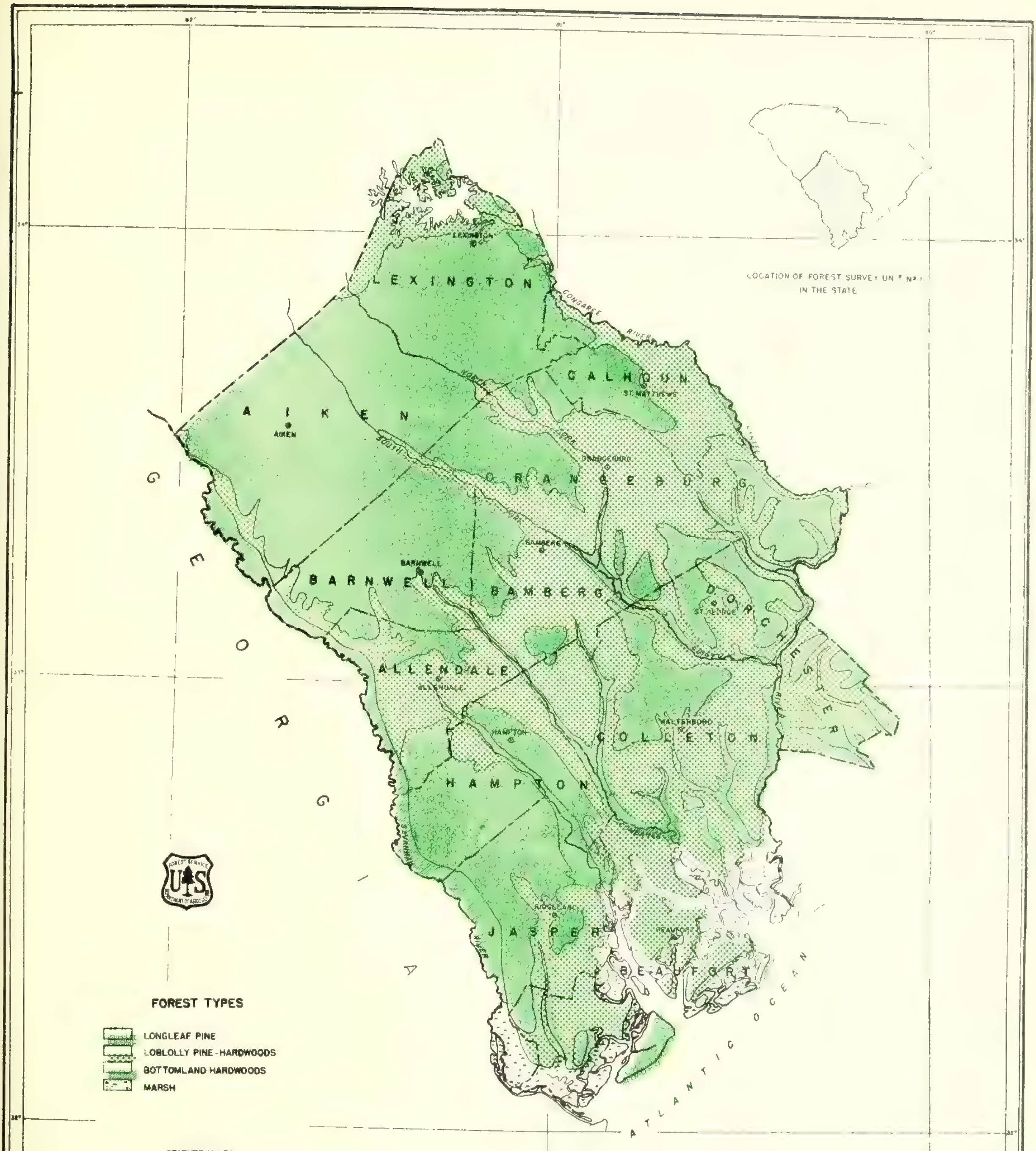
[1] Final report on Total and Partial Unemployment for South Carolina, John D. Biggers, Administrator, Washington, D. C., 1937.

[2] See Glossary for definition of terms.



MAJOR FOREST TYPES

IN THE

SOUTHERN COASTAL PLAIN OF SOUTH CAROLINA

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1936

According to the 1935 Census of Agriculture, 56 percent of the area was in farms, the proportions by counties varying from 29 percent in Jasper County to 80 percent in Bamberg. Farm woodlots, including woodland pastures, occupy nearly 1½ million acres, or about half of the forest land in the unit. Lumber and pulp companies own a number of large tracts of timber land estimated to aggregate more than 300,000 acres. Estates and game clubs also own or control extensive areas of forest land, chiefly in the coastal counties.

FOREST DESCRIPTION

The 3 million acres of forest land in this Survey unit exhibit a wide variety of physical characteristics. The flatwoods area, lying in a broad belt across the eastern counties, makes up about one-third of the forest area including some of the best pine stands in the state. Another third of the forest acreage lies in the swamps, bays, and river bottoms throughout the unit. The remaining third is in the rolling upland sections in the central and western parts of the unit, including the sandhills of Aiken and Lexington Counties.

Forest Types

For description and analysis, the several forest types recognized in the field have been combined into three type-groups, longleaf-slash pine, loblolly pine, and hardwood-cypress.

Longleaf and slash pine, with their associates, predominate on slightly less than a million acres or about one-third of the total forest area (table 2). Longleaf pine is the principal species, making up 55 percent of the cubic foot volume in the type-group. Slash pine comprises 18 percent and loblolly pine, the most common associate, accounts for 10 percent. The remaining volume consists principally of other pines, black gum, cypress, and oaks. Although the most extensive areas in the longleaf pine type-group are located in the sandhills region of Lexington, Aiken, and Barnwell Counties, the stands in these areas are generally poorly stocked with pine and have a dense understory of scrub oak which greatly handicaps the establishment of pine reproduction. The best stands of longleaf and slash pine occur in the flatwoods areas in the eastern counties.

The loblolly pine type-group, which includes small areas of shortleaf, pond, and spruce pine, occupies an aggregate area of 1,224,000 acres, approximately 41 percent of the total forest area. Loblolly pine is the predominant species, making up 55 percent of the total cubic foot volume in this type-group. The principal associated species, shortleaf and pond pines, red and black gum, together with smaller quantities of oak and other hardwoods, compose the remaining volume.

Table 2. - Productive forest area classified by forest condition and type group

Forest condition	Forest type group			Total	Proportion of total
	Longleaf-slash pine	Loblolly pine	Hardwood-cypress		
	Acres				Percent
Sawlog size:					
Old growth:					
Uncut	16,100	103,600	98,100	217,800	7.3
Partly cut	61,800	66,800	105,300	233,900	7.8
Total	77,900	170,400	203,400	451,700	15.1
Second growth:					
Uncut	327,100	524,100	255,500	1,106,700	37.0
Partly cut	29,700	159,900	37,800	227,400	7.6
Total	356,800	684,000	293,300	1,334,100	44.6
Total sawlog size	434,700	854,400	496,700	1,785,800	59.7
Under sawlog size:					
Second growth	461,500	293,300	241,000	995,800	33.2
Reproduction	53,800	73,100	67,600	194,500	6.5
Clear cut	8,900	3,200	4,800	16,900	.6
Total under sawlog size	524,200	369,600	313,400	1,207,200	40.3
Total all conditions	958,900	1,224,000	810,100	2,993,000	100.0
Percent of total	32.0	40.9	27.1	100.0	

The hardwood-cypress type-group predominates on 810,100 acres, 27 percent of the productive forest area. The most important and widespread type within this group is the bottomland and swamp hardwood association which occurs in the alluvial valleys and stream margins throughout the unit. Composed principally of black and red gum, oaks, and a number of minor commercial hardwoods, together with cypress and a scattering of loblolly pine, this group is the principal source of hardwood sawtimber in the unit.

In the deeper swamps of the large river bottoms and in the ponds and bays of the flatwoods small areas of cypress occur usually mixed with tupelo gum, black gum and occasionally slash pine. The remaining component of the hardwood type-group is made up of scattered stands of upland species, principally oaks, gums, hickory and other hardwoods, including the scrub oaks. As a dominant group, the upland hardwood association occupies only 4 percent of the total forest area.

The range of the important type groups is shown on the type map (fig. 1). No attempt is made to delineate either the non-forest land or the small areas of less prevalent types within the range of the dominant association.

Forest Conditions

Over the past three centuries, timber cutting, fire, turpentining, and abandonment of farm land have resulted in a wide variety of conditions with respect to age, size, and general utility value of the stands (table 2). In 1934, sawlog-size stands occupied more than 1-3/4 million acres, about 60 percent of the total forest area, and averaged 5,080 board feet per acre. Almost half of this acreage was dominated by loblolly pine and its associated species, and the remainder was about equally divided between the longleaf-slash pine and hardwood type-groups. Approximately one-quarter of the acreage in sawtimber stands contained timber classified as old-growth, but over half of the old-growth stands were partly cut, indicating that selected species and the best quality trees had been removed. Nearly half of the old-growth stands was in the hardwood-cypress type. The average volume of all old-growth stands was 7,710 board feet per acre (International $\frac{1}{4}$-inch rule).

Second-growth sawlog-size stands occurred on 45 percent of the forest area, principally in the pine type groups. Seventeen percent of the stands in this condition class had been partly cut. The average volume per acre for all second-growth sawlog stands was 4,190 board feet.

One of the most significant items in the whole forest condition classification is the large proportion of forest acreage in the second-growth under sawlog-size condition. At the time of the survey, one-third of all forest land was in this condition class and an additional area stocked with reproduction brought the total acreage of established young forests to nearly 40 percent of the forest area. Although only a comparatively small volume of sawtimber exists on these lands at present, they are important potential sources of lumber and other forest products. Since these stands are predominantly pine, they indicate to a large extent the general type of material that will be available for future utilization.

The small proportion of the forest area classified as clearcut, six-tenths of one percent, is an encouraging aspect of the forest situation in the unit, as it indicates that natural reforestation follows quickly after cutting and the problem of unstocked cut over areas is not serious.

As in most extensive forest areas where no planned system of forest management has been followed and where forest fires have been common, the trees in many stands are widely spaced and volumes per acre are characteristically low. This comparatively thin stocking, common throughout the southern forests, is apparent in nearly any comparison of actual yields of these areas with those of fully stocked stands. For the forests in this unit the degree of stocking may be judged by comparing the average cordwood volume per acre on the uncut pine areas with an arbitrary standard based on the best stocked 10 percent of the stands in that area weighted by site.

Average volume per acre,
uncut conditions

Age class	All pine types	Best 10 percent of pine types	Relation of volume on all pine types to volume on best 10 percent
Years	Cords	Cords	Percent
21-30	4.8	17.0	28
41-50	15.2	33.3	46
61-70	22.7	44.4	51
Weighted average all age classes	12.5	28.8	43

Although volumes per acre even larger than shown for the best 10 percent are possible under intensive management, the fact that these volumes exist on as much as 10 percent of the pine area in the uncut conditions, indicates that such densities are not unattainable objectives under fire protection and reasonable management.

TIMBER ESTIMATES

Sawtimber Volume

The total board foot volume in merchantable, sawlog-size trees (softwoods 9 inches, hardwoods 13 inches d.b.h. or larger) is listed in table 3. The volumes are net log scale, deduction having been made for material that under present practice would be left in the woods because of rot, fire scar, crook, limbiness and other defects, as well as for loss in sawing at the mill caused by sweep and interior defects.

Table 3. - Net board-foot volume classified by major species groups, by International ¼-inch, Scribner, and Doyle log rules, 1934

Major species group	International ¼-inch[1]	Scribner	Doyle
	Thousand board feet		
Pines:			
Longleaf	1,024,500	863,600	571,500
Slash	321,100	268,300	168,300
Loblolly	3,703,300	3,255,900	2,452,200
Others	714,400	618,500	414,500
Total pines	5,763,300	5,006,300	3,606,500
Hardwoods:			
Red gum	931,100	849,400	694,700
Black gum	723,900	618,600	485,500
Tupelo gum	269,800	234,800	189,100
Red oaks	458,500	424,200	359,500
White oaks	170,200	156,900	130,800
Ash	97,200	89,500	71,200
Others	504,700	454,400	353,100
Total hardwoods	3,155,400	2,827,800	2,283,900
Cypress	490,800	410,600	270,300
Total all species	9,409,500	8,244,700	6,160,700

[1] The scale by International ¼-inch rule approximates green lumber tally.

Estimates are derived from three standard log rules -- Doyle, Scribner, and International ¼-inch. The Doyle rule, although long used by the local lumber industry, is not a satisfactory measure of recoverable volume throughout the wide range of tree diameters included in this inventory. The Scribner rule, although more accurate, is likewise faulty as a basic rule for measuring volumes of trees of mixed sizes. The International ¼-inch rule, used in subsequent volume tabulations in this report, measures approximately actual recoverable volume and for practical purposes is equivalent to green lumber tally. The total volume of sawtimber in the unit, by the Doyle rule, is only 65 percent and, by the Scribner rule, 88 percent of the volume according to the International ¼-inch rule.

Table 4. - Net board-foot volume classified by species group and forest condition (International ¼-inch rule), 1934

Species group	Forest condition					Total	Proportion of total
	Sawlog size				Under sawlog size 1/		
	Old growth		Second growth				
	Uncut	Partly cut	Uncut	Partly cut			
	Thousand board feet						Percent
Pines:							
Longleaf and slash	102,000	246,600	817,500	61,700	117,800	1,345,600	14.3
Loblolly	967,900	228,700	2,000,200	413,900	92,600	3,703,300	39.3
Others	171,700	63,000	406,800	44,100	28,800	714,400	7.6
Total	1,241,600	538,300	3,224,500	519,700	239,200	5,763,300	61.2
Hardwoods:							
Red gum	327,500	118,800	408,800	61,500	14,500	931,100	9.9
Black gum	183,000	174,900	307,500	39,800	18,700	723,900	7.7
Tupelo gum	86,500	61,600	102,000	19,000	700	269,800	2.9
Red oaks	141,700	50,500	213,900	32,600	19,800	458,500	4.9
White oaks	71,700	17,300	69,500	7,300	4,400	170,200	1.8
Others	175,300	102,500	247,700	54,800	21,600	601,900	6.4
Total	985,700	525,600	1,349,400	215,000	79,700	3,155,400	33.6
Cypress	119,800	72,000	240,200	39,700	19,100	490,800	5.2
Total all species	2,347,100	1,135,900	4,814,100	774,400	338,000	9,409,500	100.0
Percent of total	24.9	12.1	51.2	8.2	3.6	100.0	

1/ Includes 14.5 million board feet on the areas classified as reproduction and clearcut.

Pine species make up 61 percent of the total sawtimber volume with loblolly pine alone accounting for nearly 40 percent of the total. Hardwood species, largely red and black gum, comprise an additional 34 percent, and the remaining 5 percent is cypress (table 4).

Nearly 31 percent of the pine volume, 48 percent of the hardwood, and 39 percent of the cypress occur in old-growth stands. Although the old-growth timber is generally the best in the unit, not all of it has the quality usually associated with original stands. Nearly one-third of it is on partly cut areas indicating that selected trees have been removed. In other cases these stands are overmature and defective. The volume in the old-growth condition classes also includes the volume of second-growth trees occurring in the old-growth stands.

Second-growth stands, including the occasional sawtimber trees in the under sawlog-size conditions make up 63 percent of the total volume. These rapidly growing stands are particularly important as they will provide the major part of the future lumber production.

The board foot volumes discussed in the previous paragraphs are aggregate estimates for the entire survey unit without regard to location, stand density or other factors which might affect their status with respect to marketing. Probably no extensive timber area in the unit is totally inaccessible to the logging operator. Indeed, 93 percent of the forest area has already been logged over. The more important factors affecting operability of the sawtimber volumes are ownership, market requirements, stocking or stand density, and size, age and quality of the timber.

An analysis of stand density based on volume per acre is illustrated in figure 2 for the sawlog-size conditions in both the pine and hardwood type groups. Many lumbermen consider that a stand, to be operable, should have at least 2,000 board feet per acre although areas yielding less than this are often logged if readily accessible. On this basis, three-fourths of the sawtimber area in the pine type carrying 94 percent of the volume would qualify. Twelve percent of the area and 38 percent of the volume occur in stands of 10,000 board feet or more per acre.

In the hardwood type-group over four-fifths of the sawtimber area and 96 percent of the volume is in stands averaging at least 2,000 board feet per acre. Sixteen percent of the area and 41 percent of the volume occur in stands of 10,000 board feet per acre or more.

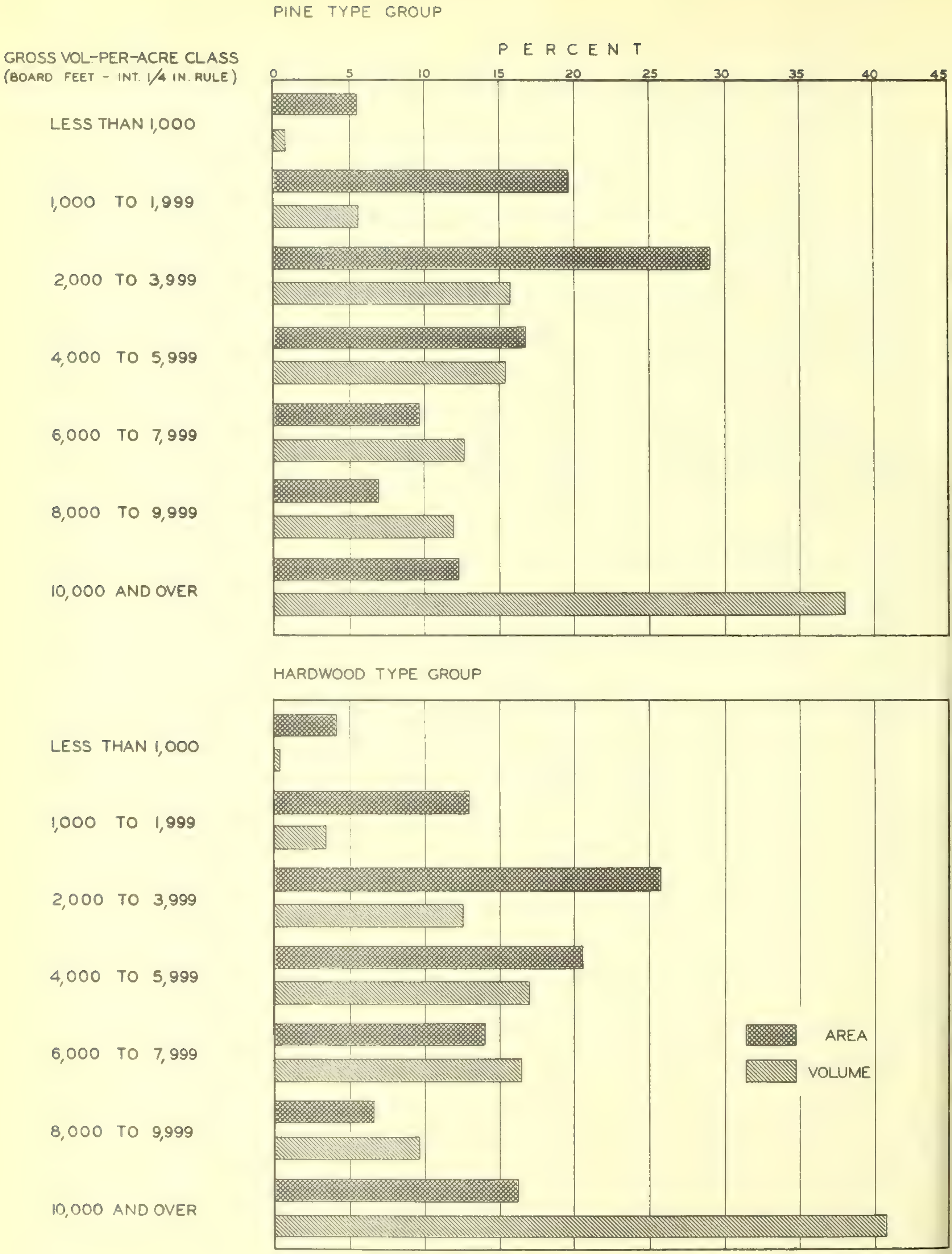


FIGURE 2.— PROPORTIONAL DISTRIBUTION OF AREA AND BOARD-FOOT VOLUME IN THE SAWLOG-SIZE CONDITIONS BY VOLUME-PER-ACRE CLASSES

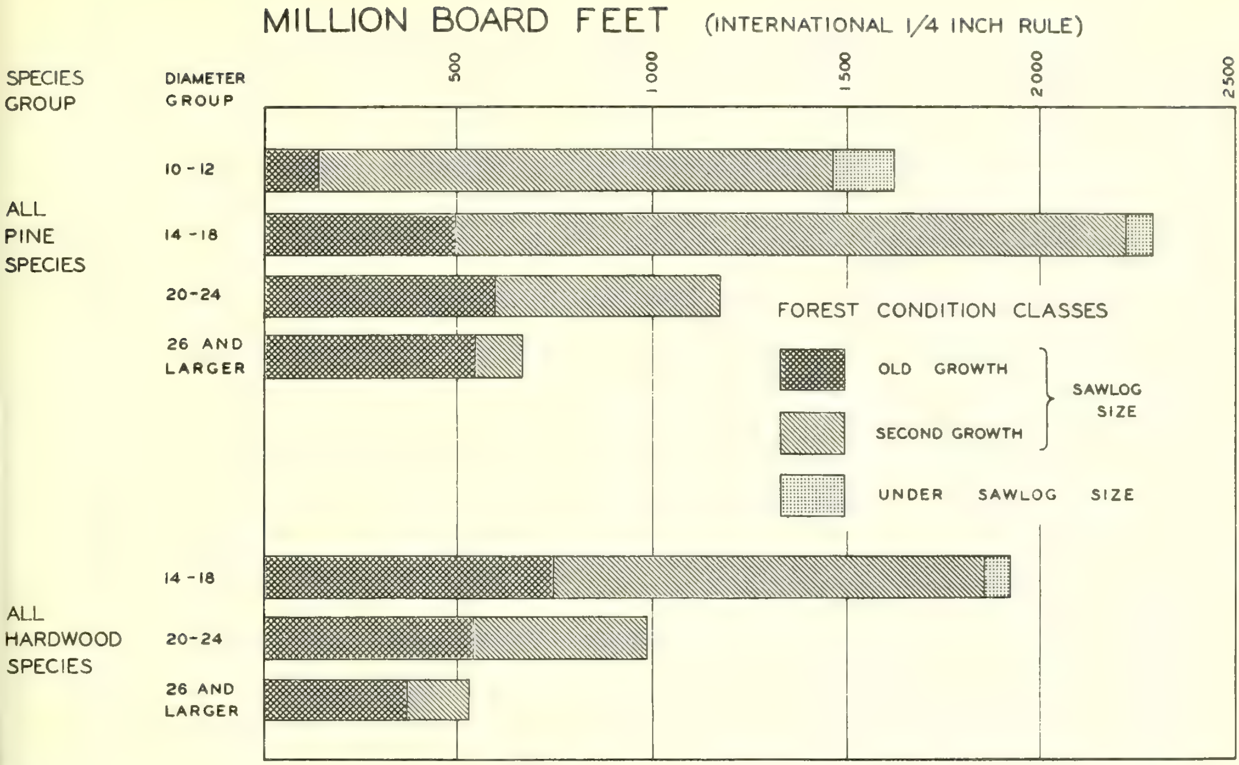


FIGURE 3.—DISTRIBUTION OF NET BOARD-FOOT VOLUME BY DIAMETER GROUP AND FOREST CONDITION

Another index of the merchantability of standing timber is given in figure 3, which shows the distribution of the board foot volume by diameter groups and condition classes for both pine and hardwood species. Nearly 30 percent of the pine volume is in the 10-12 inch diameter group and nearly 70 percent is in trees less than 19.0 inches in diameter.

In hardwoods, in which 13 inches is the minimum size for sawtimber, 55 percent of the volume is in trees in the 14 to 18-inch group and only 15 percent in the group 26 inches or larger.

The average volume per acre of pine and hardwoods is shown in table 5 by type group and condition class. In the old-growth conditions the average volume on the areas partly cut is notably lower than the volume on uncut areas, particularly in the pine type. In second-growth conditions the difference between uncut and partly cut is not as great. The average volume per acre of 3,140 board feet for all forest land is slightly less than the average of 3,300 board feet found in the Northern Coastal Plain unit of the state.

Table 5. - Average net sawtimber volume per acre classified by type group, species group, and forest condition (International $\frac{1}{4}$-inch rule)

Type group and species group	Forest condition						Average all conditions
	Sawlog size				Average all sawlog size	All under sawlog size	
	Old growth		Second growth				
	Uncut	Partly cut	Uncut	Partly cut			
	- - - - - - - Board feet per acre - - - - - - -						
Pine types:							
Species group:							
Pine	10,200	4,110	3,710	2,710	4,210	260	2,590
Hardwood	2,860	810	530	520	770	30	470
Total	13,060	4,920	4,240	3,230	4,980	290	3,060
Hardwood types:[1]							
Species group:							
Pine	210	90	250	180	200	30	140
Hardwood[2]	7,780	4,690	4,460	4,130	5,140	210	3,230
Total	7,990	4,780	4,710	4,310	5,340	240	3,370
All types:							
Species group:							
Pine	5,700	2,300	2,910	2,290	3,090	200	1,920
Hardwood[2]	5,080	2,560	1,440	1,120	1,990	80	1,220
Total	10,780	4,860	4,350	3,410	5,080	280	3,140

[1] Includes cypress type.

[2] Includes cypress volume.

Cordwood Volume

With the rapid growth of the pulp and paper industry on the eastern seaboard in the last three years, timber of a size and quality suitable for pulpwood has found a greatly expanded market. Although none of the new mills have been established in this unit, the mills at Charleston and Savannah undoubtedly will affect timber marketing at least in the eastern counties of the unit, particularly since pulp companies own extensive areas of timber in these counties. Keener competition may be expected among the major forest industries for their future supplies of pulpwood, sawlogs, and unworked turpentine pines. Table 6 is, therefore, of particular value as it shows the sound volume of all living trees 5.0 inches in diameter and larger, expressed in standard cords including bark. Cull deductions have been made only for those defects which would cause rejection of the material for cordwood.

Table 6. - Net cordwood volume (including bark) of all material classified by species group and source, 1934

Species group	Source of material				Total	Proportion of total
	Sawlog material	Tops of sawlog size trees1/	Under sawlog size trees	Cull trees		
	- - - - -	- - - - -	Cords	- - - - -	- - - - -	Percent
Pines:						
Loblolly	8,113,100	1,291,400	1,412,900	72,100	10,889,500	23.1
Longleaf2/:						
Round	1,926,700	413,500	1,609,000	13,600	3,962,800	8.4
Worked	1,188,800	475,000	404,800	19,500	2,088,100	4.5
Others	1,634,500	411,300	614,300	39,900	2,700,000	5.7
Total	12,863,100	2,591,200	4,041,000	145,100	19,640,400	41.7
Hardwoods:						
Red gum	2,191,900	1,246,500	1,668,300	438,600	5,545,300	11.8
Black and tupelo gum	2,629,500	1,252,200	4,014,100	1,106,500	9,002,300	19.1
Other pulping hardwoods	919,100	480,100	1,059,400	671,300	3,129,900	6.6
Oaks	1,500,400	871,500	1,526,200	1,214,300	5,112,400	10.8
Other nonpulping hardwoods	594,000	335,700	1,143,200	375,500	2,448,400	5.2
Total	7,834,900	4,186,000	9,411,200	3,806,200	25,238,300	53.5
Cypress	1,228,200	385,000	464,300	173,400	2,250,900	4.8
Total all species	21,926,200	7,162,200	13,916,500	4,124,700	47,129,600	100.0
Percent of total	46.5	15.2	29.5	8.8	100.0	

1/Includes the usable portion of the upper stems of pines and of the upper stems and limbs of hardwoods and cypress to a minimum diameter limit of 4 inches outside bark.

2/Includes a small quantity of slash pine.

Although hardwoods make up only one-third of the board foot volume, they comprise nearly 54 percent of the total cordwood volume. The cordwood volume more accurately expresses the true relation of hardwoods in the stands as it includes the volume of all trees 5 inches d.b.h. and larger; whereas, the sawtimber volumes include only sound softwood trees 9 inches d.b.h. and hardwoods 13 inches d.b.h. and larger.

The large volume of black and tupelo gum, particularly in under sawlog size and cull trees, is significant because these species are well adapted to the production of pulp, although to date very little gum pulpwood has been cut by the mills drawing on this area.

The sawlog material accounts for 46 percent of the total cordwood volume and the tops of sawlog trees make up an additional 15 percent suitable for fuelwood and pulpwood but available only as the trees are cut for sawtimber or other use.

Cubic-foot Volume

Cubic-foot volume is the most accurate measure of the solid wood content of trees and offers the best basis for calculation of growth and drain. The total volume of sound wood in live trees 5.0 inches in diameter and larger is therefore given in table 7 expressed in cubic feet excluding bark.

Table 7. - Net cubic foot volume (inside bark) of all material classified by species group and source, 1934

Species group	Source of material				Total	Proportion of total
	Sawlog-size trees		Under sawlog size trees	Cull trees		
	Sawlog material	Tops[1]				
	Thousand cubic feet					Percent
Pine	991.170	198.380	282.440	10,990	1.482.980	45.2
Hardwood	536.410	262.350	589.660	246.630	1.635,050	49.8
Cypress	92.520	26.930	32.480	12,680	164,610	5.0
Total	1,620.100	487.660	904.580	270.300	3.282,640	100.0
Percent of total	49.3	14.9	27.6	8.2	100.0	

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[1] Includes the usable portion of the upper stems of pines and of the upper stems and limbs of hardwoods and cypress to a minimum diameter limit of 4 inches outside bark.

Poles and Piles

Since trees suitable for poles and piles bring a premium price, an estimate has been made of the number of pine trees that contain sticks meeting the pole specifications of the American Standards Association. Nearly 16 million such trees were found in the unit at the time of the inventory (table 8). As many of these trees will be cut for lumber and pulpwood the primary value of the table is to indicate the distribution of trees by length of stick and diameter class. Nearly three-fourths of the sticks are in the 20- and 25-foot classes and over half are less than 11 inches in diameter at breast height. Only 12 percent are 35 feet or longer.

Table 8. - Number of pine poles and piles classified by length and diameter

Diameter class[1]	Length in feet						Total	Proportion of total
	20	25	30	35	40	45+		
Inches	Thousand sticks							Percent
7.0- 8.9	3,542	798	270	--	--	--	4,610	29.3
9.0-10.9	2,357	1,080	668	325	90	--	4,520	28.7
11.0-12.9	1,219	845	727	334	234	--	3,359	21.3
13.0-14.9	457	498	505	270	148	32	1,910	12.1
15.0-16.9	109	241	293	158	77	29	907	5.8
17.0-18.9	3	116	164	102	39	16	440	2.8
Total	7,687	3,578	2,627	1,189	588	77	15,746	100.0
Percent of total	48.8	22.7	16.7	7.6	3.7	0.5	100.0	

[1] Diameter 4½ feet above ground, outside bark.

Naval Stores Timber Supply

The territory considered as the field for continuing gum naval stores operations was 1,433,000 acres in 1934, and includes practically all of the longleaf-slash pine type-group area and a fraction of the others. It consists of the forest area that is used, or that may be used, for commercial turpentining operations, together with the included areas of clear-cut land and loblolly and hardwood forest types. The gross area of round timber was 928,200 acres; the working timber area 233,900 acres; and the worked-out and resting areas 270,900 acres. Approximately 51 percent of this area is in rolling uplands; 37 percent is in the flatwoods; and the remaining 12 percent is in swamps, bays, and river bottoms.

On the turpentine area there were about 90 million longleaf and slash pine trees (table 9). Nearly 10 percent of these were round trees, 9 inches d.b.h. and over, available for immediate working, and slightly over 80 percent were round trees less than 9 inches d.b.h., representing a large potential resource. The remainder were being or had been worked for naval stores. More than one and one-half million trees were worked-out and should be harvested for lumber, pulpwood or other products.

Table 9. - Round, working, resting, and worked-out longleaf and slash pine trees by turpentine area history

Turpentine area history	Round trees		Working trees	Resting trees	Worked out trees	Total
	1.0"-8.9"	9" & over				
	- - - - - - - - -	Thousands of trees	- - - - - - - - -			
Round timber area	39,741	6,681	--	125	10	46,557
Working area:						
Front-faced area	2,907	118	1,100	19	--	4,144
Back-faced area	15,794	177	3,244	790	572	20,577
Resting and worked-out area	13,901	1,482	--	2,615	931	18,929
Total turpentine area	72,343	8,458	4,344	3,549	1,513	90,207
Percent	80.2	9.4	4.8	3.9	1.7	100.0

Disregarding all faces being worked at present, an analysis of the turpentine areas with respect to future operations shows that 38 percent of the entire area was in a well developed stage containing at least 8 future faces per acre or 8 round trees 9 inches and larger. This area averaged 26 possible future faces per acre. Approximately 11 percent of the area was in advanced sapling stands, with a sufficient number of round trees, largely 8 inches, to indicate that the stands will reach the well-developed stage in the next 8 years; 15 percent was in young sapling stands, made up mainly of 2-, 4-, and 6-inch trees that will require about 16 years; and 16 percent was in reproduction and clear-cut stands that will require over 20 years to reach the well-developed stage. The remaining 20 percent was in intermingled non-turpentine areas.

Since the naval stores industry has been active in this Survey unit for more than a century, probably the general practice of working most of the longleaf and slash pines before cutting them will continue. However, the recent weak condition of the naval stores market and the activities of the Naval Stores Conservation Program are tending to decrease operations. Moreover the development of the pulp industry may result in the use of an increasing number of round turpentine pine trees for pulp, thus reducing the available supply for naval stores. If the cut of round trees is not greatly increased, there appears to be an ample supply of longleaf and slash pines in this Survey unit to maintain the naval stores industry at the 1936-37 level.

An additional source of naval stores exists in the seasoned stumps of old-growth longleaf and slash pine trees. No attempt has been made to commercialize this resource in South Carolina although elsewhere in the naval stores region stump wood distillation is an important industry. In 1934 the Survey found that 123,200 acres of forest land in the unit had 6 or more seasoned usable old-growth stumps per acre and of this area 62,800 acres had 14 or more stumps per acre. It is estimated that there were on these areas 451,000 tons of stumps that could be salvaged by blasting. If mechanical stump pullers were used, this volume could be increased about two-thirds.

Forest Increment

Forest increment as used in this report is the net balance after deducting the volume lost through mortality from the gross growth on all sound trees. Growth includes not only the volume accruing annually to merchantable trees but also the volume added by small trees reaching the minimum merchantable sizes during the year. The growth on cull trees and on the tops of sawlog-size hardwoods and cypress is not included.

During 1936 the total gross growth of sawlog material amounted to 487,100,000 board feet (table 13). Deducting the mortality of 166,600,000 board feet leaves a net increment of 320,500,000 board feet. Similarly, the entire growing stock had a gross growth of 128,360,000 cubic feet; mortality amounted to 52,430,000 cubic feet, leaving a net increase of 75,930,000 cubic feet (table 14).

Mortality includes the volumes lost through the death of trees by overcrowding, fire, disease, insect attack, and windthrow. In 1936 these losses amounted to 41 percent of the gross cubic-foot growth. Part of this loss was due to elimination of the weaker individuals, a natural and unavoidable process of stand development when forests are not under intensive management. A large proportion of the mortality losses, however, is due to unnatural causes, chiefly fire and turpentining. As a direct cause, fire is a major contributing factor to mortality, particularly in the seedling and sapling stages. In older stands fire also leaves a large number of scarred and weakened trees highly susceptible to insect and fungus attack and to windthrow.

Turpentining in the longleaf and slash pine stands causes a considerable direct loss in volume of usable wood, and an indirect loss through retarded growth. Moreover, the chipping of turpentine faces creates a highly inflammable fuel in the gum-soaked faces and open cups and gutters. Fire in these stands usually burns hotter than in the loblolly or round longleaf and slash pine stands and reaches higher toward the tree crown, leaving many "dry faces" and deep fire wounds open to insects and disease. Deep chipping and the practice of working small trees contribute to heavy windfall losses. During 1934 loss of increment from turpentining is estimated at 53 million board feet. Of this loss, increased mortality amounted to 28 million board feet, retarded growth to 19 million board feet and the butt volume lost in turpentined trees to about 6 million board feet.

Table 10. - Average net increment per acre, 1934

Forest condition	Sawlog-size material			All sound material[1]	
	Pines	Hardwoods and cypress	Total	Including bark	Excluding bark
	Board feet			Cords	Cu.ft.
Sawlog size:					
Old growth:					
Uncut	33	134	167	.46	31.5
Partly cut	Neg.	87	87	.36	23.6
Second growth:					
Uncut	116	54	170	.50	35.4
Partly cut	79	57	136	.33	23.1
Under sawlog size:					
Second growth	37	7	44	.27	18.2
Reproduction and clearcut	4	1	5	.01	.8
Weighted average all conditions	64	43	107	.36	25.1

[1] Does not include increment on tops and limbs of hardwoods and cypress.

For comparison with other forest areas, the average net increment per acre is shown in table 10, by forest conditions and broad species groups. The weighted average net increment of 107 board feet per acre, although not so high as that of the Northern Coastal Plain of South Carolina (149 bd. ft.) is nevertheless well above the general average for Coastal Plain survey units farther south.

ECONOMIC ASPECTS

Since colonial days, the forests have played an important part in the economic development of the region. The extensive stands of longleaf and slash pine in the original forests early led to the establishment of a thriving naval stores industry which reached its peak of production in the latter part of the 19th century, followed by a decline to its lowest point about the time of the World War. Since 1920 there has been some recovery but the industry has never regained its dominant position in the unit.

The lumber industry in the unit has had its greatest development since the turn of the century, reaching its peak of production in the boom years of 1923-29 followed by a rapid decline to 1932, the low point of the depression. Subsequent production has tended to follow the general trend of national lumber production.

The recent development of the pulp industry in the South brings an important new element into the forest utilization picture. Although no pulp mills have been constructed in this unit, the new mills at Georgetown and Charleston, South Carolina, and Savannah, Georgia, will draw part of their requirements from this unit and will have an appreciable effect on the forest economy of the region.

During 1935 a survey of the wood-using industries was made to ascertain production for the calendar year 1934, and a similar canvass in 1937 for the years 1935 and 1936. These surveys covered the production of lumber, veneer, and cooperage, pulpwood and piece products, and of both domestic and commercial fuelwood. Because neither of the new pulp mills in Charleston and Savannah was in full operation in 1936, the drain figures include only a small part of their normal drain requirements.

Lumber Industry

A total of 138 sawmills operated in the unit in 1936. Ninety mills, or 65 percent of the total, were small portable type mills cutting less than 10 thousand board feet per 10-hour day; 29 mills cut from 10-19 thousand per day; 9 cut 20-39 thousand and the remaining 10 mills had capacities of 40 thousand board feet or more per day. During 1936 the cut of these mills amounted to 222,500,000 board feet, 31 percent of which was manufactured by the small mills cutting less than 20 thousand board feet per day. Cutting practically all pine, the portable mills generally operated in woodlots and stands too scattered or of too low quality to attract larger mills.

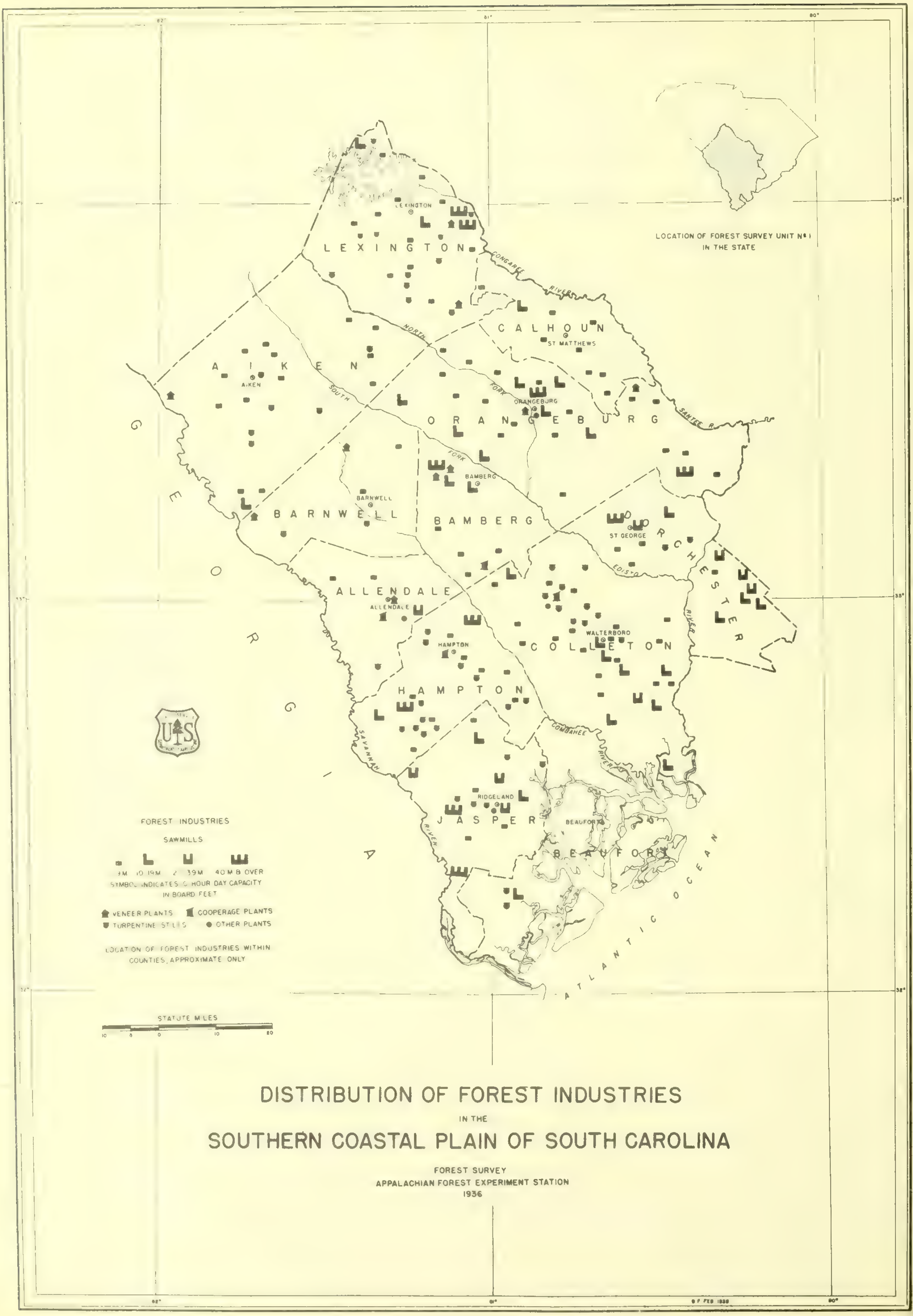
DISTRIBUTION OF FOREST INDUSTRIES
IN THE
SOUTHERN COASTAL PLAIN OF SOUTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1936
LOCATION OF FOREST SURVEY UNIT No 1 IN THE STATE
FOREST INDUSTRIES
SAWMILLS
-9M
10-19M
20-39M
40 M & OVER
SYMBOL INDICATES 10 HOUR DAY CAPACITY IN BOARD FEET
VENEER PLANTS
COOPERAGE PLANTS
TURPENTINE STILLS
OTHER PLANTS
LOCATION OF FOREST INDUSTRIES WITHIN COUNTIES, APPROXIMATE ONLY
STATUTE MILES
10
5
0
10
20
LEXINGTON
Lexington
CALHOUN
St Matthews
AIKEN
Aiken
ORANGEBURG
Orangeburg
BARNWELL
Barnwell
BAMBERG
Bamberg
DORCHESTER
St George
ALLENDALE
Allendale
COLLETON
Walterboro
HAMPTON
Hampton
JASPER
Ridgeland
BEAUFORT
Beaufort
GEORGIA
ATLANTIC OCEAN
CONGAREE RIVER
NORTH FORK
SOUTH FORK
SANTEE R.
EDISTO
RIVER
COMBAHEE RIVER
SAVANNAH RIVER
82°
81°
80°
34°
33°
32°

Figure 4

Except for Allendale, Beaufort, and Barnwell counties, where only a few were operating in 1936, the distribution of small mills was fairly uniform (fig. 4).

Miscellaneous Wood-using Industries

Eighteen non-lumber plants scattered in the central and western counties produced veneer, cooperage and miscellaneous items such as shingles, handles, and furniture blanks. Fuelwood, crossties, poles and piles, and fence posts made up a substantial part of the total wood volume produced in the unit. The production of fuelwood alone, generally a noncommercial activity, accounted for nearly 573,000 cords of wood, a total volume second only to that used by the lumber industry. Nearly three-fourths of the fuelwood was cut from cull and dead trees, limbs and mill waste and does not constitute a drain on the forest growing stock.

Naval Stores Industry

During the 1936-37 naval stores season there were 428 crops (10,000 cups per crop) in operation and production amounted to 14,180 units (a naval stores unit of one 50-gallon barrel of turpentine and 3-1/3 500-pound barrels of rosin) valued at about $800,000. A total of 35 stills located chiefly in Hampton, Colleton, Lexington, Aiken and Jasper counties, were active.

Employment

The labor requirements of all forest industries totaled approximately 1,897,000 days (table 11). Thirty-nine percent of the employment was provided by the lumber industry, much of it as part-time work in the small mills. The production of fuelwood required 35 percent. The naval stores industry, including gum producers without stills accounted for 276,000 man-days or 15 percent. The remaining 11 percent, about 213,000 man-days, was required for the production of veneers, crossties, poles, cooperage, fence posts, and a few other miscellaneous products. On the basis of 250 working days of 10 hours each per year, the forest industries would provide regular full-time employment to nearly 7,600 workers. But with a large number of part-time employees, particularly in small sawmills and in fuelwood production, the actual number of workers involved was undoubtedly several times this number.

Table 11. - Production and employment in the primary wood-using industries, 1936

Commodity	Number of plants	Quantity produced	Employment		
			In woods	At plant	Total
			- - Thousand man-days - -		
		M bd. ft.			
Lumber	138	222,500	286	450	736
Veneer	10	16,500	31	64	95
		Pieces			
Poles and piles	--	73 M	16	--	16
Crossties	--	247 M	34	--	34
Fence posts	--	1,013 M	15	--	15
		Cords			
Cooperage	4	13,600	14	17	31
Other commercial uses	4	15,700	15	7	22
Fuelwood	--	572,800	672	--	672
		Units			
Naval stores	35	14,180	259	17	276
Total			1,342	555	1,897

Commodity Drain

Commodity drain is the volume of wood cut for industrial and domestic use from sound living trees. It includes the material cut in the unit and shipped outside for manufacture and the volume lost in waste incidental to logging. It does not include the volume cut from cull trees or the tops of hardwood or cypress.

The total commodity drain for 1936 is shown in table 12 for both the sawlog-size material expressed in board feet and for all material, including sawlog volume, in cubic feet (inside bark). The board-foot volumes include the material cut for all products from the stems of sound trees of sawlog-size. The cubic foot volumes include the material cut for all products from all sound trees 5.0 inches in diameter and larger.

Table 12. - Commodity drain from sound trees, 1936

Commodity	Sawlog-size material			All material[1]			Proportion of total
	Pine	Hardwood[2]	Total	Pine	Hardwood[2]	Total	
	Thousand board feet			Thousand cubic feet			Percent
Lumber	151,000	77,100	228,100	29,190	11,630	40,820	66.3
Veneer	1,500	16,300	17,800	260	2,330	2,590	4.2
Cooperage	5,700	400	6,100	980	60	1,040	1.7
Pulpwood	1,900	--	1,900	600	--	600	1.0
Poles and piles	6,900	--	6,900	1,370	--	1,370	2.2
Crossties	6,800	4,100	10,900	1,580	660	2,240	3.6
Fuelwood	26,300	28,000	54,300	6,130	4,030	10,160	16.5
Miscellaneous	3,600	3,700	7,300	1,390	1,370	2,760	4.5
Total	203,700	129,600	333,300	41,500	20,080	61,580	100.0

[1] Does not include volume cut from tops of hardwoods and cypress.

[2] Includes cypress.

Lumber production accounted for 68 percent of the drain from sawlog-size trees and 66 percent of the total commodity drain. Although only one-fourth of the total fuelwood consumed was considered as drain, fuelwood was the next largest in volume, comprising 16 percent of the drain from sawlog-size trees and 17 percent of the drain from all trees. Approximately two-thirds of the total commodity drain is pine. Cypress, included with hardwoods in the tables, makes up only 5 percent of the board-foot drain.

COMPARISON BETWEEN INCREMENT AND COMMODITY DRAIN

The net change in the amount of growing stock between January 1, 1936, and January 1, 1937, and the factors responsible for it are summarized in tables 13 and 14. These tables disclose the magnitude and final effect of the elements of growth, mortality, and drain during 1936.

Table 13. - Comparison between increment and commodity drain, sawtimber material

	Pine	Hardwood and cypress	Total
	- - - - Thousand board feet - - - -		
Growing stock, January 1, 1936	5,816,500	3,664,100	9,480,600
Growth	317,600	169,500	487,100
Mortality	-124,900	-41,700	-166,600
Forest increment	192,700	127,800	320,500
Commodity drain	-203,700	-129,600	-333,300
Net change in growing stock, 1936	-11,000	-1,800	-12,800
Growing stock, January 1, 1937	5,805,500	3,662,300	9,467,800

The sawtimber material as a whole was reduced approximately 13 million board feet (table 13). The sawlog-size pine growing stock alone was reduced 11 million board feet, and the volume of hardwood and cypress nearly 2 million board feet.

Table 14. - Comparison between increment and commodity drain, all material

	Pine	Hardwood and cypress	Total
	- - Thousand cubic feet (i.b.) - -		
Growing stock, January 1, 1936	1,474,920	1,290,820	2,765,740
Growth	72,620	55,740	128,360
Mortality	33,190	19,240	52,430
Forest increment	39,430	36,500	75,930
Commodity drain	41,500	20,080	61,580
Net change in growing stock, 1936	-2,070	+16,420	+14,350
Growing stock, January 1, 1937	1,472,850	1,307,240	2,780,090

In table 14 a similar analysis of all growing stock, sawtimber and cordwood material combined, presents a more favorable balance. Expressed in cubic-foot measure, there was a 14 million foot increase in the total inventory although the pine volume was reduced by more than 2 million cubic feet. The margin of excess drain in sawtimber and the surplus growth in cubic-foot material is too small to be conclusive evidence of positive trends either toward an increased growing stock or an overcutting of the sawtimber stands. The body of timber has been so reduced in acreage and in volume from that of the original stands that in their present condition almost any major economic change will shift the balance toward increased growing stock or a reduction in the inventory. This is brought out in table 15, which shows the total inventory annually from January 1, 1934, to January 1, 1937.

Table 15. - Changes in the growing stock

Date	Sawtimber material				All growing stock material
	Species-group			Total	
	Pines	Hardwood	Cypress		
	- - - - - - - Thousand board feet			- - - - - - -	Thousand cu.ft.(i.b.)
January 1, 1934	5,769,100	3,155,400	490,800	9,415,300	2,723,450
January 1, 1935	5,798,400	3,161,400	486,800	9,446,600	2,747,630
January 1, 1936	5,816,500	3,187,600	476,500	9,480,600	2,765,740
January 1, 1937	5,805,500	3,192,100	470,200	9,467,800	2,780,090

During this three-year period, the cubic foot growing stock increased steadily through the post-depression years, including the minor peak year of 1936. The sawlog inventory also increased during 1934 and 1935, but dropped off during the industrially active year 1936. Although no accurate data are now available to continue the record through 1937 and 1938, general indications are that industrial activity slackened, particularly in 1938. To offset the effect of the retarded activity among established wood-using industries, a new permanent market was opened late in 1936 with the construction of the two new pulp mills in nearby Charleston and Savannah. The effect these mills will have on forest conditions is not yet known but it is significant to note that if one-third of their combined capacity requirements had been drawn from the sound pine trees of this unit in 1936, the commodity drain would have been increased approximately 25 percent. Instead of a 2 million cubic-foot deficit, as shown in table 14, there would have been a reduction in the pine growing stock of nearly 13 million cubic feet.

SUMMARY

The southern Coastal Plain of South Carolina is particularly well suited to the production of forest products and there are many good reasons to believe that the business of growing timber for wood products and naval stores will become increasingly important in the Coastal Plain of South Carolina. More than half of the total land area is forested with commercially valuable, rapidly growing pine and hardwood species. The market for forest products is diversified and expanding, and both land and water transportation facilities are readily available. The labor supply is adequate. Finally, there is a distinctly encouraging and helpful attitude on the part of public agencies, private corporations, and individuals toward the development and protection of the forest resources.

Considering the long period of timber exploitation, land clearing and repeated burning, the extent and generally good condition of the timber stands today are excellent criteria of the ability of the area to sustain timber growth. There appears to be little demand for new cropland, and the large acreage of abandoned agricultural land found in 1934 indicates that the area in forest will gradually increase as reproduction becomes established. At the time of the survey, 60 percent of the forest area was classified in the sawlog-size condition -- largely second growth. Stands of 2,000 board feet or more per acre, which usually may be considered operable, occur on 46 percent of the forest area. Clear cut areas where little or no stocking exists amount to less than one percent of the total forest area, one of the lowest ratios of any Survey unit in the South.

These conditions are encouraging. They form the physical basis upon which to expand and intensify the efforts of forest-minded individuals and agencies whose work is already beginning to show beneficial results. The principal problem with respect to the forest resources is now one of increasing the yield to a standard compatible with the costs of development and the industrial and social economics concerned.

A number of deficiencies in the present forest stands materially reduce the annual net yield. Although most of the forest area is in the sawlog-size condition, 23 percent (409.100 acres) of the area in this condition class contains stands with less than 2,000 board feet per acre. Many of the stands in both the sawlog-size and under sawlog-size conditions are understocked and contain an excessive number of cull trees and weed species. An extensive area of turpentine timber has been fully exploited for its gum-producing possibilities, and the worked-out trees should be removed to make room for new crops of round timber. Mortality is excessively high. Much of the loss, however, especially that due to fire and poor naval stores practice, can be eliminated.

The comparison of growth and drain for 1936 indicates that the forests cannot continue to support the sawtimber requirements at that rate without depleting the growing stock. This situation may be somewhat alleviated by an increased production of the under sawlog-size material, which is apparently enjoying a steady, although slow, increase. Against this possible relief, however, must be debited the additional drain to come from the operations of the two new pulp mills. Consideration must likewise be given to the fact that lumber production in 1936, although the highest since 1930, nevertheless was below the 1920-1930 average, so that resumption of manufacturing activity comparable to that decade probably would create a serious overdrain on the current inventory.

The Naval Stores situation is favorable for gum naval stores production at the 1936 level but any outlook for the future of the industry is conditional upon the activity of wood-using industries, particularly pulp mills, the degree of acceptance accorded the Naval Stores Conservation Program, world market conditions, the development of central stilling, and the production of naval stores at pulp mills and wood distillation plants.

Considering the resource, its present rate of growth, and the industrial structure dependent upon it, it appears that the present forest stands are slowly losing ground and are likely to continue to do so unless more efficient use is made of the potentialities inherent in the forest soils and tree species.

The forests are fully capable of producing sufficient timber to meet present requirements and to allow for a further industrial expansion. It is a matter of direct concern to the forest industries and timberland owners of this unit to see that a definite policy of sound forest management and efficient wood utilization is accorded widespread acceptance. The foundation of such a policy is adequate fire protection and improved cutting practices designed to build up and maintain the forest in a more productive condition.

In recent years, many constructive programs have been placed in operation by government agencies, industrial interests, and private individuals. The South Carolina Commission of Forestry, in cooperation with the United States Forest Service, is constantly expanding its fire protection areas and aiding county governments and private associations in lowering the annual losses caused by uncontrolled fire. During 1938, about 48 percent of the forest area in this unit was under some form of organized fire protection.

The new pulp mills established on the coast have announced the policy of managing their timberlands with a view toward sustained yield and integrated utilization. Rules have been set up for guidance of contractors cutting pulpwood on both company and private holdings. Other forest owners, particularly lumber companies, estates and naval stores operators, have initiated various forms of timber and land management on their properties. The State Commission of Forestry maintains an active management division to advise timberland owners in reforestation and cutting practices. The Extension Service through the State Extension Forester and the county agents is actively engaged in teaching the principles of good forest practice to the farm woodlot owners.

These activities are encouraging indications of an increasing realization of the value of good forest practice in developing the forests of the region to a highly productive condition. Much remains to be done, however, to insure a timber production adequate to maintain existing industries and to permit future expansion. The fire control organization must be strengthened and extended to include the 52 percent of the forest area now without protection. Through extension work and public cooperation the private forest land owners must be aided in applying good forest practices on their own holdings. Research is necessary to develop methods of cutting that will insure satisfactory reproduction of desirable species and rapid growth of high quality timber. Utilization studies should be made to determine new markets, particularly for the large volume of cull trees and species at present having little commercial value. Methods of integrated utilization must be developed to permit the use of cull trees, thinnings and tops for such products as fuelwood and pulpwood, reserving the better trees for sawtimber and other high quality products.

Through a concerted attack on these problems by both public and private agencies the productiveness of the forests can be increased to the point where they will contribute the maximum to the social and economic well being of the unit.

GLOSSARY

General

Forest survey unit. -- A subdivision of a state containing from 4 to 10 million acres in which forest, topographic and economic conditions are reasonably homogeneous.

Land-use Classes

Productive forest area. -- Forest land capable of producing timber of commercial quality.

Non-productive forest area. -- Forest land that does not have the qualities necessary for the production of commercial timber.

Cropland. -- Land being used for the production of farm or orchard crops, or showing evidence of having been so used during the preceding 5 years, and still in such condition that it can be easily cultivated.

Abandoned cropland. -- Land formerly cultivated or pastured and now showing distinct signs of having been abandoned for such use.

Pasture. -- Cleared or open land under fence, used primarily for grazing.

Forest Type Groups

Longleaf-slash pine. -- Stands in which pines make up more than 25 percent of the sawtimber volume or, in young stands, more than 25 percent of the dominant and co-dominant stems, with longleaf or slash pine predominating. This group includes both the pure longleaf and slash pine types, and the mixed type, longleaf-slash pine-hardwoods.

Loblolly pine. -- Stands in which pines make up more than 25 percent of the sawtimber volume or, in young stands, more than 25 percent of the dominant and co-dominant stems, with loblolly or other non-turpentine pines predominating. This group includes both the pure pine types and the pine-hardwood types. Small areas of pond pine, spruce pine and shortleaf pine types are also included.

Hardwoods-cypress. -- Stands in which hardwoods or hardwoods and cypress make up 75 percent or more of the sawtimber volume or, in young stands, 75 percent or more of the dominant and co-dominant stems.

Forest Conditions

Sawlog Size

Old growth, uncut. -- Areas with stands composed predominantly of trees of sawtimber size having the characteristics of the original, mature timber of the region and containing at least 1,000 board feet per acre of merchantable species in hardwood types, and 600 board feet per acre in pine types -- with less than 10 percent of the volume cut.

Old growth, partly-cut. -- Areas with old growth stands from which 10 percent or more of the volume has been cut, leaving a minimum of 1,000 board feet per acre in the hardwood types, or 600 board feet per acre in the pine types.

Second growth, uncut. -- Areas with stands of second growth having at least 600 board feet per acre in trees of sawlog size, and with less than 10 percent of the sawtimber trees cut.

Second growth, partly-cut. -- Areas with stands of second growth in which 10 percent or more of the sawtimber trees have been cut but with the remaining stand containing 600 or more board feet per acre.

Under Sawlog Size

Second growth. -- Areas with young second growth stands in which the volume of timber in trees of sawtimber size is less than 600 board feet per acre with the remainder of the trees under sawtimber size.

Reproduction. -- Areas not qualifying for any of the above conditions but having at least 80 well established and well distributed seedlings and sprouts of commercial species per acre.

Clear-cut. -- Cut-over areas having insufficient young growth to qualify for second-growth or reproduction conditions.

Turpentine Area Classification

Round timber area. -- Areas made up almost entirely of unturpentined longleaf and slash pine stands, ranging from reproduction to old growth.

Working area. -- Areas on which trees are being chipped. May be further classified as front-faced if the trees are cupped for their first set of faces, or back-faced if a significant portion has a second set of faces.

Resting area. -- Areas which have been worked in the past and which exhibit sufficient opportunities for a second set of faces on worked trees and for a first set of faces on round trees to justify further operations.

Worked-out area. -- Areas on which the turpentining possibilities have been exhausted and which must await the growth of an adequate number of round trees before working can be resumed.

Diameters

D.b.h. -- Diameter breast high. The diameter outside the bark of a tree measured at a point 4½ feet above the ground.

Diameter classes. -- All trees were recorded in 2-inch diameter classes, that is, trees measuring 5.0 to 6.9 inches d.b.h. are in the 6-inch diameter class.

Tree Classification

Sawlog-size tree. -- A pine or cypress tree at least 9.0 inches d.b.h., or a hardwood tree at least 13.0 inches d.b.h., with not less than one sound butt log 12 feet long, or with 50 percent of the gross volume of the tree in sound sawtimber.

Under sawlog-size tree. -- A sound pine or cypress tree measuring 5.0 to 8.9 inches d.b.h., a sound hardwood tree measuring 5.0 to 12.9 inches d.b.h.

Cull tree. -- Any tree which, because of form, limbiness, rot, or other defect fails to qualify as a sawlog or under-sawlog-size tree.

Pole or pile tree. -- A pine tree from which a pole or pile could be cut conforming in general to the pole specifications set up by the American Standards Association.

Round tree. -- A longleaf or slash pine tree that has not been worked for naval stores.

Working tree. -- Longleaf and slash pine trees that are now being worked for naval stores.

Resting tree. -- Previously worked longleaf and slash pine trees that are now resting prior to the working of back faces.

Worked-out tree. -- Longleaf and slash pine trees on which all possible faces have been worked. These trees have served their purpose in the production of naval stores and are now available for other uses.

Volume Estimates

Cordwood volume. -- This volume (including bark) is derived from the following sources:

1. The sawlog portion of sawtimber trees.
2. That portion of sawtimber trees not usable as sawlogs but acceptable as cordwood. This includes the upper stems of pines, and the upper stems and limbs of hardwoods and cypress to a minimum diameter limit of 4 inches outside bark.
3. The sound under-sawlog-size trees at least 5 inches d.b.h. in which the entire stem is included to a variable top diameter not less than 4 inches outside bark.
4. The estimated sound material in cull trees.

Deductions for cull include only the volume in defects which cause the material to be unsuited for cordwood. Sweep and slight crook are not regarded as defects.

Standard cord. -- A stacked pile of round or split wood bolts measuring 4 x 4 x 8 feet and estimated to contain 90 cubic feet of wood and bark in pine and cypress species, and 80 cubic feet of wood and bark in hardwood species.

Forest Growth

Cubic foot. -- The volume inside bark accruing to all sound trees 5.0 inches d.b.h. and larger, plus the volume in sound trees reaching this specified minimum diameter during the period for which growth is computed.

Board foot. -- The volume accruing to sound pine and cypress trees 9.0 inches d.b.h. and over and hardwood trees 13.0 inches d.b.h. and over, plus the volume in sound trees reaching these respective diameters.

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FOREST SURVEY RELEASE NO. 4 APRIL 1, 1940

FOREST RESOURCES OF THE SOUTHERN COASTAL PLAIN OF NORTH CAROLINA

by

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A FOREST SURVEY PROGRESS REPORT

E. V. Roberts, Regional Survey Director

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

Appalachian Forest Experiment Station
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PREFACE

Through the McSweeny-McNary Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act, and each of the 12 Regional Experiment Stations was made responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station, Asheville, North Carolina.

The work of the Survey is divided into 5 major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of the timber on these lands.

2. Growth. Determination of the current rate of timber growth.

3. Drain. Determination of the amount of industrial and domestic wood use, and the total loss resulting from fire, insects, disease, suppression, and other causes.

4. Requirements. Determination of the current and probable future requirements for forest products by all classes of consumers.

5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis for public and private policies and plans of forest land use and management.

This progress report presents preliminary information on the first three of these phases for the Southern Coastal Plain of North Carolina, one of the 4 units into which the state was divided. Similar releases will be published for the other units of the state which are the Northern Coastal Plain, the Piedmont Region, and the Mountain Region.

Information on the physical forest resources was obtained by a field survey made in the spring of 1937. A total of 10,248 sample plots were established at intervals of one-eighth of a mile on compass lines 10 miles apart, extending across the unit in a northeast direction. The statistical sample obtained from these plot records forms the basis for all area and volume estimates in this report, except where other sources are directly credited. Owing to the method of sampling data, small tabular items have the greater probability of error and should be considered as indicating relative magnitude rather than actual values.

Data on consumption of forest products for industrial and domestic purposes were obtained by canvassing all primary manufacturing plants and a number of representative domestic consumers.

Forest Survey Staff Assisting in the Preparation of this Report

Field inventory	W. E. Houser, In charge
Compilation and analysis of inventory, growth and drain data	G. E. Morrill, In charge T. C. Evans

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FOREST RESOURCES OF THE SOUTHERN COASTAL PLAIN OF NORTH CAROLINA

DESCRIPTION OF THE UNIT

North Carolina Forest Survey Unit 1 is composed of a group of 21 counties situated in the southeastern portion of the State (fig. 1). It lies in the drainage basins of the Neuse, Cape Fear, and Pee Dee Rivers, and occupies about one-half of the State's coastal plain area, extending inland about 125 miles. This unit, of 8,333,500 acres, covers 27 percent of the total area of the State and includes 30 percent of the forest land.

It is primarily a farm and forest region, with about 55 percent of the land in farm ownership, and with forest land, including that on farms, occupying 67 percent of the unit area. Wilmington, near the mouth of the Cape Fear River, is the largest city (1930 pop. 32,000), and Goldsboro, Fayetteville, and Kinston each have more than 10,000 inhabitants. According to the 1935 Census of Manufactures there were only 22,000 people employed in all manufacturing industries in the unit, and they received only 6 percent of all the wages paid by manufacturers in the State during that year.

Physical Conditions

The Coastal Plain comprises two rather distinct topographic areas; the Tidewater and the Western Coastal Plain. The Tidewater area extends inland 30 to 50 miles from the Atlantic Ocean. It is a low, level, poorly drained region, generally less than 50 feet above sea-level. Several hundred thousand acres lie in almost impenetrable swamps. The Western Coastal Plain, situated between the Tidewater country and the Piedmont Plateau to the west, is level or gently rolling. It rises gradually to an elevation of 500 feet above sea-level along the "fall line" where the Coastal Plain meets the Piedmont Plateau. The Sandhills, a distinctive part of the Western Coastal Plain, extend from Sanford, in Lee County, southwestward along the western boundary of the unit to South Carolina. They occupy a belt about 30 miles wide and have a gently rolling surface which is 400 to 500 feet above sea level.

The better-drained soils of the Tidewater area are sands and sandy loams of the Portsmouth and Norfolk series that are well adapted to both agricultural and forest crop production. The muck soils of the swamps are not always suitable for cultivation even when drained artificially. With the exception of the Sandhills the soils in the Western Coastal Plain are silt and sandy loams, represented largely by the Norfolk series. These soils are easily worked but must be heavily fertilized to produce large yields of agricultural crops. The Sandhill soils are chiefly coarse sand, sand, and sandy loam, nearly all of the Norfolk series. They have little natural fertility but when well fertilized are adapted to the production of peaches and truck crops. Forest stands grow well on all except the muck soils of the Tidewater area and the most sterile sands of the Sandhills.

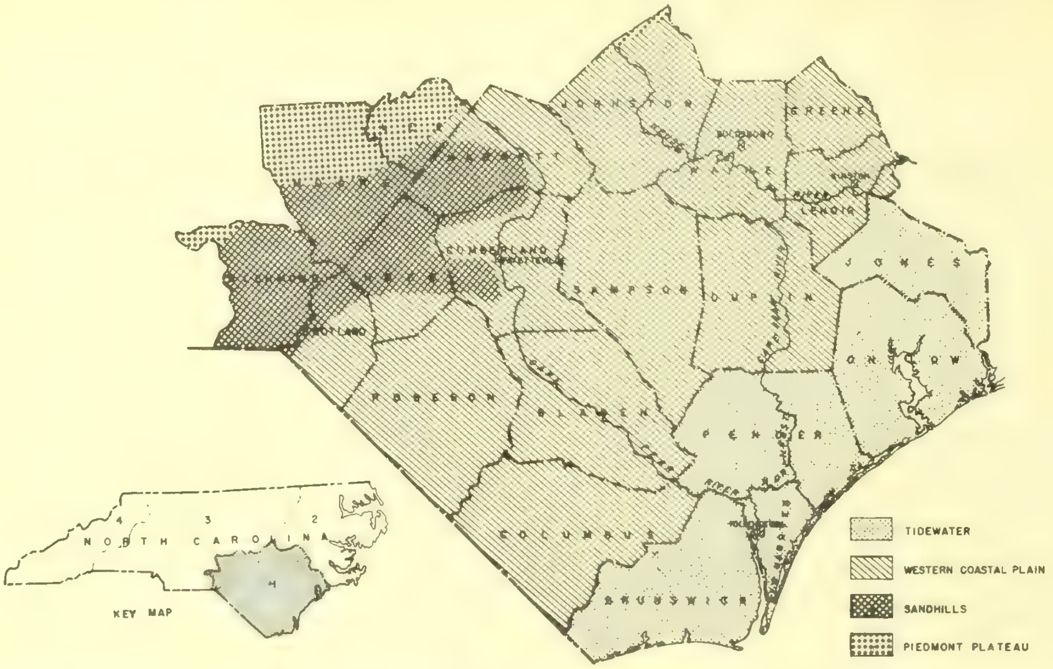

FIGURE 1 - PHYSICAL DIVISIONS OF NORTH CAROLINA UNIT 1

Economic Conditions

Most of the Scotch and English people who settled in this area more than 200 years ago came from Virginia and South Carolina. The increase in population was slow until around 1890. At that time the agricultural population began to increase rapidly since turpentining and subsequent lumbering had cleared large areas of land adaptable to cultivation. According to the Bureau of the Census, the population of 392,000 in 1900 increased to 664,000 by 1930. During this latter year 60 percent of the people lived on farms, 24 percent lived in small towns or rural communities, and 16 percent lived in towns of more than 2,500 inhabitants. In the Tidewater counties, where swamps and forest land are extensive, the population is less than 35 per square mile, in contrast to the Western Coastal Plain counties where more industrialization and expanded agricultural activity caused an increase to about 60 people per square mile.

In 1935 about 207,000 persons were employed; 80 percent in agriculture, 10 percent in manufacturing, 5 percent in retail trade, 1 percent in wholesaling, and 4 percent in miscellaneous industries.1/ Of the 22,000 engaged in manufacturing, 14,000 were employed in the textile industry and 5,000 in the forest products industries. The enumeration of employees in

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1/United States Department of Commerce, Census of Agriculture, 1935, and Consumer's Market Data Handbook, 1935.

the textile industry is fairly accurate, because of large, fixed plants, but such is not the case in the forest products industries where small plants and part time woods work are common. A more detailed discussion of forest employment will be given later in this report.

According to the Census of Agriculture the 4.6 million acres in farms produced crops valued at 77 million dollars in 1934. The chief source of farm income was the tobacco crop, valued at 41 million dollars in 1934. Only 39 percent of the farm acreage was cropland, however, as 54 percent was woodland and 7 percent was in other uses. Corn, cotton, hay, and tobacco occupied 92 percent of all the cropland harvested, but forest land on farms exceeded the combined area in these crops by 1 million acres.

Manufacturing in the unit is concentrated upon the production of textiles and forest products. Although important in certain localities, manufacturing is a minor part of such activity in the state, accounting for only 9 percent of the employees, 6 percent of the payroll, and 6 percent of the value added by manufacture.2/ The textile industry is represented by nearly 50 mills, located in or adjacent to the sandhill region. The plants manufacturing forest products are much smaller than the textile mills. About 500 primary plants, such as sawmills, and more than 30 secondary plants, such as furniture factories, are distributed throughout the unit. These two major industries employed at least 90 percent of those engaged in manufacturing in 1935.

The Atlantic Coast Line and the Seaboard Air Line Railway systems own and operate practically all of the railroads. From Wilmington the railroads extend in a fan-like pattern but they are so widely separated that large areas in the Tidewater counties are more than 10 miles from rail facilities, in contrast to the Western Coastal Plain counties where main-line and inter-connecting roads are more closely distributed. The highway system is generally well developed. Brunswick, Columbus, Duplin, and Pender counties have few paved tributary highways because much of their area is in extensive swamps containing few inhabitants. The Intracoastal Waterway skirts the unit behind the "banks" along the ocean and provides a channel at least 8 feet deep for water-borne traffic. The Cape Fear River is adapted to ocean going vessels up to Wilmington, and at least an 8-foot depth is maintained as far upstream as Fayetteville, over 100 miles from the sea.

In 1937 the assessed value of all real and personal property in this unit was 387 million dollars, or 16 percent of the assessed value of the state.3/ In Bladen, Cumberland, Harnett, and Onslow counties the assessed value of forest land and timber was 12 percent of the assessed value of all

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2/United States Department of Commerce, Census of Business, 1935.

3/North Carolina Reference and Industrial Directory, Department of Conservation and Development, Raleigh, North Carolina.

real and personal property.[4] If it is assumed that this proportion is representative of the unit, the assessed value of all forest land and timber was about 45 million dollars in 1937.

Taxes on forest land vary widely between counties and even between townships of the same county. For taxation purposes forest land is generally classified by tax assessors as wasteland, cutover land, woodland and timber land. Very little uniformity exists between counties in their allocation of forest land into these 4 classes. Data obtained in 1937 in the counties mentioned above provide an indication of the range in assessments, tax rates, and taxes per acre but radical variations from these values may exist in adjacent counties or townships. Wasteland was assessed at $1.25 to $5.85 per acre, cutover land at $5.91 to $9.91, woodland at $3.75, and timberland at $4.48 to $16.16 per acre. The average tax per acre varied from 2.3 cents on wasteland to 29.2 cents on timberland. The county-wide tax rate, exclusive of special school or road district levys, ranged from $1.25 to $1.81 per $100 of assessed valuation.

The ownership of forest land is approximately as shown in table 1. Federal lands consist of the forested portion of Fort Bragg Military Reservation in Hoke and Cumberland Counties, the portion of the Croatan National Forest lying in Jones County, and two areas leased to the North Carolina Department of Conservation and Development; one in Richmond, Moore, and Scotland Counties, and the other in Bladen County.

State lands are made up of school lands held in scattered tracts by the State Board of Education, the Hoffman Forest in Jones and Onslow Counties that is controlled by a Forestry Foundation and used as a school forest by North Carolina State College, and an area in Pender and Onslow Counties transferred from the State Board of Education to the Department of Conservation and Development in 1939.

Farm woodlands comprise about half of the forest land held in private ownership. The average farm contains 34 acres of woodland. Nearly every farm contains some wooded acreage so that the 2.5 million acres of farm forest are controlled by almost 73,000 different operators. Johnston County has the most farm woodland (219,000 acres) but Brunswick County, with 76 percent of all its farm-owned land in forest, has the highest proportion.[5] The industrial and other private owners who possess 2.7 million acres of forest land are chiefly pulp and paper companies, lumber companies, investment concerns, railroads and private estates. Ownership records show that approximately 10 percent is in ownerships of 50,000 acres or more, 10 percent is in tracts of 10,000 to 50,000 acres, and the rest is in holdings of less than 10,000 acres.

Sustained yield forestry is not widely practiced. Two pulp companies have together about 100,000 acres under sustained yield. Approximately 240,000 acres, owned by 13 lumber, box, pulp and veneer companies, are being managed with sustained yield as the ultimate objective. It is probable that many owners of small private holdings are on sustained yield but the acreage so handled is not known.

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[4] Nelson, R. W.; Taxation of Forest Property in North Carolina, Forest Taxation Inquiry, U. S. Forest Service.

[5] United States Department of Commerce, Census of Agriculture, 1935.

Table 1. - Ownership of forest land, 1939.

Ownership	Distribution of forest area	
	Acres	Percent
Federal:		
Military Reservations	110,500	)
National Forests	26,400	) 4
Leased to N. C. Dept. of Cons. and Dev.	100,000	)
State:		
State Board of Education	35,000	)
Forestry Foundation (State College)	82,000	) 3
North Carolina Dept. of Cons. and Dev.	40,000	)
Private:		
Farm Woodlands[1]	2,452,700	44
Industrial and other private	2,697,700	49
Total all forest land	5,544,300	100

[1] 1935 Census of Agriculture.

After more than 200 years of settlement only 30 percent of the land is used for agricultural crops (table 2). There are, however, many farms (73,000) and a large farm population. Throughout much of the unit, tobacco, cotton, and garden truck are produced by intensive farming on small acreages. The prevalence of forest land is due in part to this small-scale farming and, to a greater degree, to the prevailing soil and drainage conditions. Certain of the sand-hill soils are so sterile that crop production is impractical. Wide areas in the Tidewater counties will remain forested as past experience indicates the value of these soils for agriculture does not justify the cost of drainage. More than three-fourths of the Tidewater area is forested, compared to less than two-thirds of the Western Coastal Plain. The heavy demand made upon soil fertility by tobacco culture leads to a slow cycle of tobacco-land abandonment and forest-land clearing for new cropland (table 2).

Table 2. - Total land area classified according to major use, 1937

Land use[1]	Area	Proportion of total area
	Acres	Percent
Forest:		
Productive[2]	5,544,300	66.5
Nonproductive	13,800	.2
Total forest	5,558,100	66.7
Nonforest:		
Agriculture:		
Old cropland	2,327,300	27.9
New cropland	84,600	1.0
Pasture	82,100	1.0
Total agriculture	2,494,000	29.9
Abandoned cropland	47,200	0.6
Other nonforest	234,200	2.8
Total nonforest	2,775,400	33.3
Total area	8,333,500	100.0

[1] Refer to glossary for description of terms.

[2] Productive forest area used throughout the report.

DESCRIPTION OF THE FOREST RESOURCE

As early as 1894 W. W. Ashe[1] observed that "The distribution of the pines and the respective area occupied by each in this state has changed a great deal since the first exploration of the country." Of the original coastal plain forest he states, "The longleaf pine formerly extended over the entire area under consideration, growing upon the drier portion of the sand. In the southern and southwestern counties it formed a forest of pine unmixed with other trees. Loblolly pine was originally confined to the lower and moister land, especially where it was loamy or slightly clayey, over the entire coastal region and westward beyond it about 40 miles."

Species and Forest Types

In the present-day forest longleaf pine is of minor importance. Only scattered stands occur in the Tidewater country; notably around Wilmington in New Hanover County, south of Jacksonville in Onslow County, and around Parkersburg in Sampson County. A fairly large area of second-growth longleaf pine occupies the Sandhills, chiefly in Richmond, Moore, Hoke and Scotland counties. Here the black jack and turkey oaks are associated with it, while on the lower land near the coast, loblolly and pond pines make up an appreciable part of the longleaf type

Pond pine is more widely distributed than longleaf pine. It is very abundant in White Oak, Angola, Holly Shelter, and Green Swamps, also along the South River in Bladen and Sampson Counties, and in northwestern Pender County (fig. 2). Stands of pond pine are more nearly homogeneous in composition than other stands in the unit but a considerable volume of loblolly and longleaf pine, black, red, and tupelo gum, white cedar, and cypress is found in the pond pine-hardwoods type (table 3).

Loblolly pine is the most plentiful species in the unit. It occupies all topographic situations and is associated with all species, except with cypress and tupelo in the wettest swamps. It accounts for 76 percent of the volume in the loblolly pine-hardwood type and for 7 to 10 percent of the volume in each of the other types (table 3).

Many hardwood species flourish throughout the unit but no single species dominates the forest stand over wide areas. Hardwood trees are an integral part of the extensive pine types but the hardwood types are found along the streams, on flats bordering the larger swamps, and in scattered patches in the uplands. Because of differences in quality and proportionate occurrence of species the hardwood stands were classified in 2 broad types: the bottomland hardwoods and the upland hardwoods. Black, red, and tupelo gums make up more than half of the volume in the bottomland hardwood type. The oaks are most common in the upland hardwood type.

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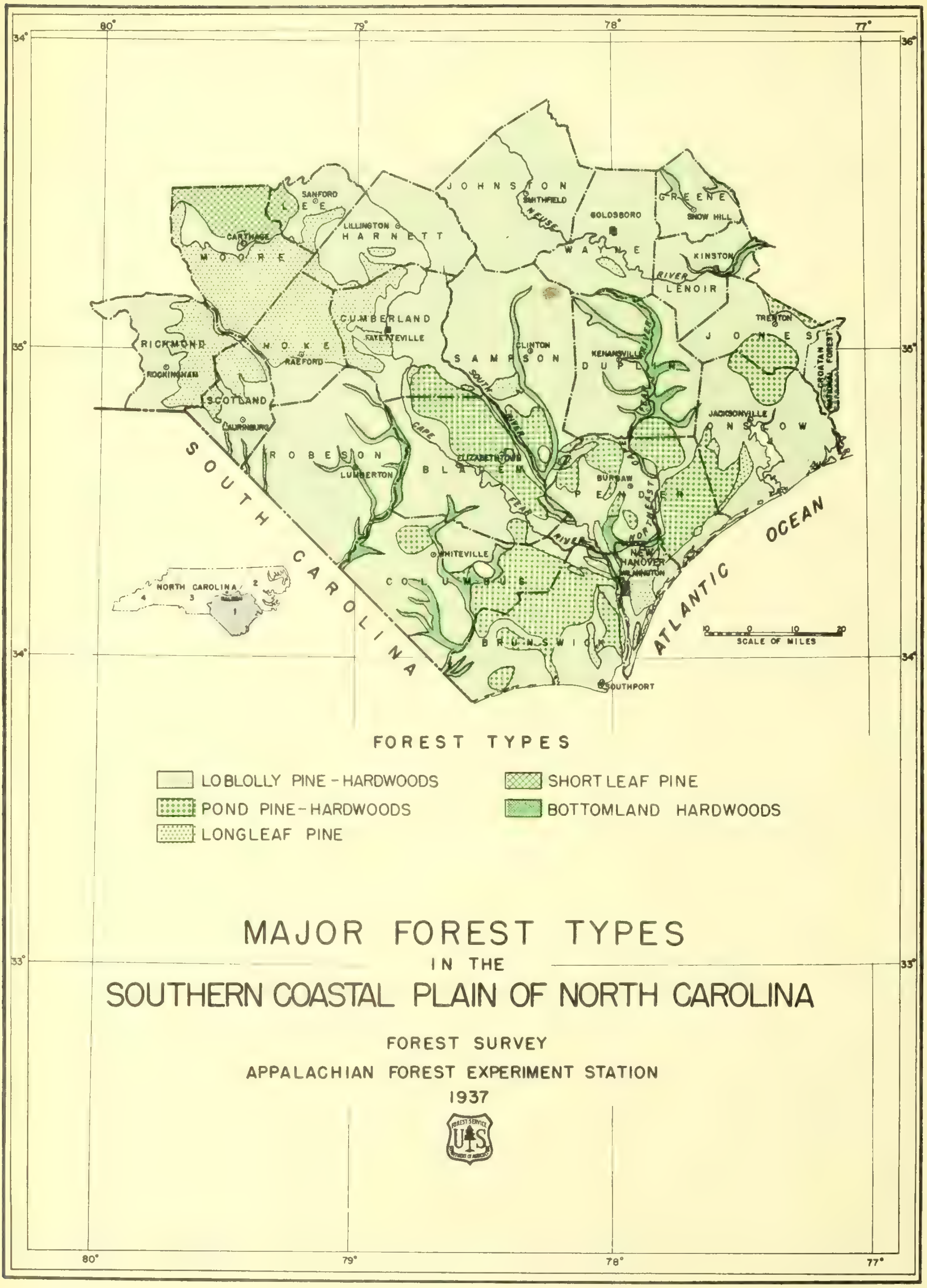
[1] Ashe, W. W. The Forests, Forest Lands, and Forest Products of Eastern North Carolina. Bul. 5., North Carolina, Geological Survey, 1894.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SMITHFIELD
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GOLDSBORO
WAYNE
GREENE
SNOW HILL
KINSTON
RIVER
LENOIR
TRENTON
JONES
CROATAN NATIONAL FOREST
SANFORD
LEE
LILLINGTON
HARNETT
CARTHAGE
MOORE
CUMBERLAND
FAYETTEVILLE
RICHMOND
ROCKINGHAM
HOKE
RAEFORD
SCOTLAND
LAURINBURG
SAMPSON
CLINTON
SOUTH RIVER
DUPLIN
KENANSVILLE
JACKSONVILLE
ONSLOW
ROBESON
LUMBERTON
CAPE FEAR RIVER
BLADEN
ELIZABETHTOWN
BURGAW
PENDER
NORTHEAST
NEW HANOVER
WILMINGTON
WHITEVILLE
COLUMBUS
BRUNSWICK
SOUTHPORT
SOUTH CAROLINA
NORTH CAROLINA
1
2
3
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RALEIGH
ATLANTIC OCEAN
SCALE OF MILES
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20
FOREST TYPES
LOBLOLLY PINE-HARDWOODS
POND PINE-HARDWOODS
LONGLEAF PINE
SHORTLEAF PINE
BOTTOMLAND HARDWOODS
MAJOR FOREST TYPES
IN THE
SOUTHERN COASTAL PLAIN OF NORTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1937
FOREST SERVICE
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Figure 2

Table 3. - Species composition of the forest types.

Species	Loblolly pine-hardwoods[1]	Pond pine-hardwoods	Longleaf pine	Upland hardwoods	Bottomland hardwoods	All types
	- - - - - - - - Percent of cubic volume (o.b.) - - - - - - - -					
Loblolly pine	75.7	6.8	8.7	9.6	7.8	43.9
Pond pine	1.2	81.7	4.6	Negl.	0.6	8.3
Longleaf pine	2.5	3.6	78.8	2.6	0.1	6.6
Shortleaf pine	4.4	Negl.	0.1	3.3	0.1	2.5
White cedar	0.1	0.7	Negl.	--	0.7	0.3
Cypress	0.3	0.5	Negl.	0.1	8.6	2.6
Red gum	3.8	0.4	0.3	10.9	14.9	6.7
Black and tupelo gum	3.7	3.8	0.8	3.0	37.0	12.9
Yellow poplar	1.0	0.6	0.2	3.6	2.9	1.5
Red oaks	2.3	Negl.	1.3	19.6	6.4	3.9
White oaks	2.0	Negl.	1.0	23.4	2.1	2.6
Ash	Negl.	--	--	0.8	4.1	1.2
Holly, dogwood, persimmon	0.4	Negl.	0.1	1.5	0.8	0.5
Scrub hardwoods[2]	0.8	0.2	3.9	6.9	1.4	1.3
Other hardwoods	1.8	1.7	0.2	14.7	12.5	5.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

[1] Includes the shortleaf pine-hardwoods type.

[2] Scrub oaks, redbud, sassafras, etc.

The loblolly pine-hardwood type, occupying over 40 percent of the forest area, is the most extensive in the unit (table 4). Because this type has restocked abandoned fields and cut-over longleaf land it is widely distributed in the lowlands and rolling uplands. Nearly 20 percent of the forest area is in the pond pine-hardwood type, located chiefly in the less accessible swamps and flatwoods. Logging and frequent fires have reduced the saw-timber area in this type, but sprout growth and natural seeding have produced large areas of reproduction and young second growth. The longleaf pine type, once the most extensive in area, now occupies only 815,000 acres, 15 percent of the forest land. It is about equally distributed between the rolling uplands of the Sandhills and the level lowlands of the Tidewater counties. It is probable that this type will be gradually replaced by loblolly-hardwoods, except on the Sandhills. The upland hardwood type, chiefly on the rolling uplands, is found on only 7 percent of the forest area. Scrub oak stands having little value make up nearly one-third of the area of this type. Seventeen percent of the forest land is in bottomland hardwoods type. Slightly more than half is in the main river bottoms, the rest is in swamps and level lowlands. Bladen, Columbus, Duplin, and Robeson counties contain the largest concentrations of bottomland hardwoods.

Table 4. - Forest area classified according to forest type and topography, 1937

Forest type	Rolling uplands	Level lowlands	Swamps bays, and ponds	River bottoms	Total	Proportion of total
	Acres					Percent
Loblolly pine-hardwoods	772,600[1]	1,270,200	191,000	83,000	2,316,800	41.8
Pond pine-hardwoods	26,000	247,200	792,900	--	1,066,100	19.2
Longleaf pine	390,300	424,500	--	--	814,800	14.7
Upland hardwoods	325,200	78,900	--	--	404,100	7.3
Bottomland hardwoods	--	122,000	298,400	522,100	942,500	17.0
Total	1,514,100	2,142,800	1,282,300	605,100	5,544,300	100.0
Percent of total	27.3	38.7	23.1	10.9	100.0	

[1] Includes 133,400 acres in the shortleaf pine-hardwoods type.

Forest Conditions

About half of the forest land supports stands of sawlog size (table 5). One-fourth of the area in these merchantable stands contains old-growth timber, much of which has been sorted over for the best quality logs or for particular species. Three-fourths, or 2.1 million acres, of the sawlog-size stands are second-growth timber. Nearly two-thirds of the total second-growth saw-timber acreage is in the loblolly pine-hardwoods type.

Under-sawlog-size stands occupy 49 percent of the total forest area. They contain a large volume of young growing stock that will contribute to the volume of saw timber in the future. The acreage of young second growth is fairly evenly divided among the forest types but two-fifths of the reproduction area is located in the pond pine-hardwoods type. Only 2 percent of the forest land is clear-cut. This acreage is distributed throughout the unit in small tracts, most of which will restock naturally if protected from fire.

Within each forest type there is a predominant forest condition. The loblolly pine-hardwood type has the highest proportion (60 percent) of its area in second-growth sawlog-size stands. Types having a large share of their area in under-sawlog-size stands include: pond pine-hardwoods, 63 percent; longleaf pine, 76 percent; upland hardwoods, 75 percent. The bottomland hardwoods type has 38 percent of its area stocked with old-growth stands.

Table 5. - Forest area classified according to forest condition and forest type, 1937

Forest condition	Loblolly pine hardwoods[1]	Pond pine-hardwoods	Longleaf pine	Upland hardwoods	Bottomland hardwoods	Total all types	Proportion of total
	Acres						Percent
Sawlog size:							
Old growth:							
Uncut	44,700	75,700	6,500	2,400	138,200	267,500	4.8
Partly cut	94,400	48,000	64,200	30,900	216,300	453,800	8.2
Total	139,100	123,700	70,700	33,300	354,500	721,300	13.0
Second growth:							
Uncut	740,800	211,400	89,400	28,500	165,100	1,235,200	22.3
Partly cut	650,600	56,900	31,800	39,800	100,000	879,100	15.8
Total	1,391,400	268,300	121,200	68,300	265,100	2,114,300	38.1
Total sawlog size	1,530,500	392,000	191,900	101,600	619,600	2,835,600	51.1
Under sawlog size:							
Second growth	662,700	438,300	461,100	280,500	224,500	2,067,100	37.3
Reproduction	87,800	206,600	116,300	22,000	89,400	522,100	9.4
Clear-cut	35,800	29,200	45,500	--	9,000	119,500	2.2
Total under sawlog size	786,300	674,100	622,900	302,500	322,900	2,708,700	48.9
Total all conditions	2,316,800	1,066,100	814,800	404,100	942,500	5,544,300	100.0
Percent of total forest area	41.8	19.2	14.7	7.3	17.0	100.0	

[1] Includes shortleaf pine-hardwoods type.

Site

Site quality determines the timber producing power of forest land. A commonly accepted index of site quality is the height growth of average dominant forest trees. In the extensive area occupied by loblolly pine the forest land was classified according to site quality on the basis of the total height of dominant loblolly pine trees at 50 years of age. This classification showed that such areas are capable of producing excellent stands of loblolly pine because nearly 80 percent of the area had at least a 70-foot site index. The rolling uplands are least productive; the best sites are those in the bottomlands of the larger rivers. The occurrence of sites by topographic divisions is given on the next page.

Topographic division	90 or more	70 and 80	60 or less
	Percent of area		
Rolling uplands	3	70	27
Level lowlands	2	76	22
Bays, ponds, swamps	5	84	11
River bottom lands	13	84	3
Average	3	75	22

Site index in feet

Age

The dominant trees in the old-growth stands of both pine and hardwood range in age from 70 to 300 years. Second-growth sawlog-size pine stands are characterized by trees 30 to 60 years old, although pond pine stands of this size class are often 10 to 20 years older. In the hardwood stands the merchantable second-growth trees are commonly 50 to 90 years old. Second-growth pine and hardwood stands below sawlog size contain a preponderance of trees 15 to 25 years old, but they range in age from 10 to 50 years. Practically all the trees in the reproduction condition are less than 10 years old.

Stocking

Natural restocking has produced a stand of second-growth trees on practically all of the cut-over forest land. Frequent fires, cutting and the vagaries of natural seeding have created an irregular stand with stocking that varies from thin to above normal. In the pine types the average cordwood volumes per acre of uncut stands on the best-stocked 10 percent of the pine area correspond approximately with full stocking as determined by MacKinney and Chaiken.[2] A comparison of the average cordwood volume per acre in representative age-classes of all uncut stands with these fully stocked stands shows that understocking is prevalent throughout the pine area (table 6). The younger average stands are most poorly stocked, only 36 percent in the 21 to 30 year age-class, but as they grow older stocking gradually improves for the 51 to 60 year-old average stands are 55 percent stocked.

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[2] MacKinney, A. L., and Chaiken, L. E., Volume, Yield, and Growth of Loblolly Pine in the Mid-Atlantic Coastal Region. Tech. Note No. 33, Appalachian Forest Experiment Station, April, 1939.

Table 6. - Average volumes per acre, by age-classes, in the uncut conditions of the pine-hardwood types

Age-class (years)	Based on all stands	Based on best 10 percent of stands	Relation of all stands to best 10 percent
	- - - - - - - Cords	- - - - - - - -	- - Percent - -
21 - 30	6.4	18.0	36
31 - 40	13.0	28.5	46
41 - 50	19.2	37.0	52
51 - 60	24.1	43.9	55
Weighted average of all age-classes	10.2	23.5	43

Intensive forest management should produce volumes per acre closely approaching those on the best 10 percent of the pine area, but there is little likelihood of intensive forestry being applied immediately on a unit-wide scale. Minimum measures which are entirely practical and reasonable, such as more effective fire control and conservative cutting, should increase the average volume per acre by at least one-half, or from 10 up to 15 cords. Obvious benefits are greater yields per unit of area owned, more raw material for dependent wood-using industries, and better quality timber.

Fire

At the time of the survey in 1937 indications of past fires were discernible on 82 percent of the forest land. The burned acreage has accumulated over a period of years, as only a small part of the forest is burned over in a normal year. The frequency and intensity of fire varies noticeably with the forest type. Practically all of the pond pine-hardwood type has been burned over, and on 22 percent of its area the fire was heavy enough to kill saw-timber trees. Ninety-eight percent of the longleaf type showed evidence of fire, but serious injury to the trees and reproduction was apparent on only 19 percent of the area. The loblolly pine-hardwood type had a smaller proportion (80 percent) of its area burned. In this type the reproduction and smaller trees are often killed outright and after a short time the dead trees decay and disappear so that the damage is less noticeable. Evidence of past fires was present on 84 percent of the upland hardwood acreage and 52 percent of the bottomland hardwood. Although generally of light intensity, these fires kill the young trees and are responsible for a large part of the butt-rot in the hardwoods.

THE VOLUME OF THE FOREST RESOURCE

Estimates of the volume of sound wood in this area are presented in board feet, in cords, and in cubic feet. The board-foot volume includes only sound sawlog-size trees and is the material suitable for such products as lumber, veneer, and crossties. The cordwood volume includes both the board-foot material and the sound material in culls, tops, and small trees. Both wood and bark are included in cordwood but not in cubic-foot volumes, otherwise these volumes are identical.

Board-foot Volume[1]

The net board-foot volume of standing timber is 12.3 billion board feet, expressed in the International $\frac{1}{4}$-inch log rule (table 7). In this table the same volume of wood is also computed by the Scribner and Doyle log rules, affording a comparison of the results obtained with these widely used scales. The noticeably smaller volumes obtained with the Doyle rule are primarily the result of several factors: (1) the rule greatly under-scales small logs, (2) a large part of both the pine and hardwood saw timber is in second-growth stands containing a high proportion of small trees, (3) pine trees down to 9.0 inches d.b.h. and hardwood trees down to 13.0 inches d.b.h. are included in the board-foot volume. The lower diameter range in the pine contributes to the wide difference between the Doyle and International volumes, a disparity that is less noticeable in the larger hardwoods.

More than half of the total saw timber and three-fourths of the pine saw timber is in a single species -- loblolly pine (table 8). Black and tupelo gums are the principal hardwood species, making up 10 percent of the total board-foot volume and 35 percent of the hardwood volume.

One fourth of the pine volume and two-thirds of the hardwood volume is in old-growth stands. About half of this old-growth volume is in stands that have been subjected to one or more cuttings which usually removed the highest quality material. Part of the volume is in second-growth trees that occur in the old-growth stands. Only 22 percent of the loblolly pine volume is in the old-growth condition in contrast to 80 percent of the black and tupelo gum volume.

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[1] See glossary for detailed description of material included in board-foot volume.

Table 7. - Net volume by the International, Scribner, and Doyle rules classified according to species-group, 1937

Species-group	International[1]	Scribner	Doyle
	Thousand board feet		
Pines:			
Loblolly	6,367,700	5,458,000	3,699,100
Pond	1,001,600	833,400	515,400
Longleaf	837,000	710,000	472,900
Shortleaf	246,200	202,200	124,300
Total pines	8,452,500	7,203,600	4,811,700
Hardwoods:			
Black gums[2]	1,184,700	1,091,100	874,400
Red gum	843,000	770,500	603,600
Yellow poplar	221,900	202,900	158,000
Red oaks	421,900	389,400	325,700
White oaks	163,800	152,200	125,400
Ash	105,200	95,100	71,800
Other hardwoods	400,900	354,200	276,600
Total hardwoods	3,341,400	3,055,400	2,435,500
Cypress[3]	467,100	411,700	293,600
Total all species	12,261,000	10,670,700	7,540,800

[1] The scale by this rule approximates green lumber tally.

[2] Includes black and tupelo gums throughout the report.

[3] Seven percent of this volume is white cedar.

The second-growth volume is 62 percent of the total board-foot volume, or 7.7 billion feet. Six-tenths of this volume is in second-growth stands that have been undisturbed by cutting, where the volumes per acre are generally favorable for logging. The partly-cut second-growth stands contain three-tenths of the second-growth volume. Cutting in these stands usually has removed the larger trees and more valuable species. One-tenth of the second growth is in scattered sawlog-size trees in under-sawlog-size stands. Some of these trees are residual from earlier stands, but the larger part are so young that they have only recently attained sawlog size. Many of those adjacent to saw-timber stands will be cut, but the small scattered ones probably will not be utilized in the near future.

Table 8. - Net volume by the International $\frac{1}{4}$-inch rule classified according to species-group and forest condition, 1937

Species-group	Sawlog size				Under sawlog size[1]	Total	Proportion of total
	Old growth		Second growth				
	Uncut	Partly cut	Uncut	Partly cut			
	Thousand board feet						Percent
Pines:							
Loblolly	745,700	634,500	3,128,700	1,582,300	276,500	6,367,700	51.9
Pond	234,500	102,700	432,300	99,100	133,000	1,001,600	8.2
Longleaf	38,900	284,300	264,000	104,800	145,000	837,000	6.8
Shortleaf	19,100	15,400	70,700	121,800	19,200	246,200	2.0
Total pines	1,038,200	1,036,900	3,895,700	1,908,000	573,700	8,452,500	68.9
Hardwoods:							
Black gums	439,900	505,900	138,100	80,900	19,900	1,184,700	9.7
Red gum	265,700	252,600	182,700	121,400	20,600	843,000	6.9
Yellow poplar	21,500	65,500	89,800	42,400	2,700	221,900	1.8
Red oaks	94,800	139,900	118,400	56,900	11,900	421,900	3.5
White oaks	29,400	64,700	38,600	24,300	6,800	163,800	1.3
Other hdwds.[2]	173,900	148,000	114,100	51,400	18,700	506,100	4.1
Total hardwoods	1,025,200	1,176,600	681,700	377,300	80,600	3,341,400	27.3
Cypress	200,900	128,400	75,900	49,700	12,200	467,100	3.8
Total all species	2,264,300	2,341,900	4,653,300	2,335,000	666,500	12,261,000	100.0
Percent of total	18.5	19.1	38.0	19.0	5.4	100.0	

[1] Includes the reproduction and clear-cut conditions.

[2] Includes chiefly ash, maple, bay, hickory, elm, beech and birch.

A large part of the board-foot volume is in small trees (fig. 3). Forty-two percent of the pine volume is in the 10- and 12-inch d.b.h. classes. These sizes are commonly used for lumber but larger trees would yield better quality material and provide more opportunity for profit. Only 40 percent of the hardwood and cypress volume is in trees 20 inches and larger, where most of the first-grade logs occur.

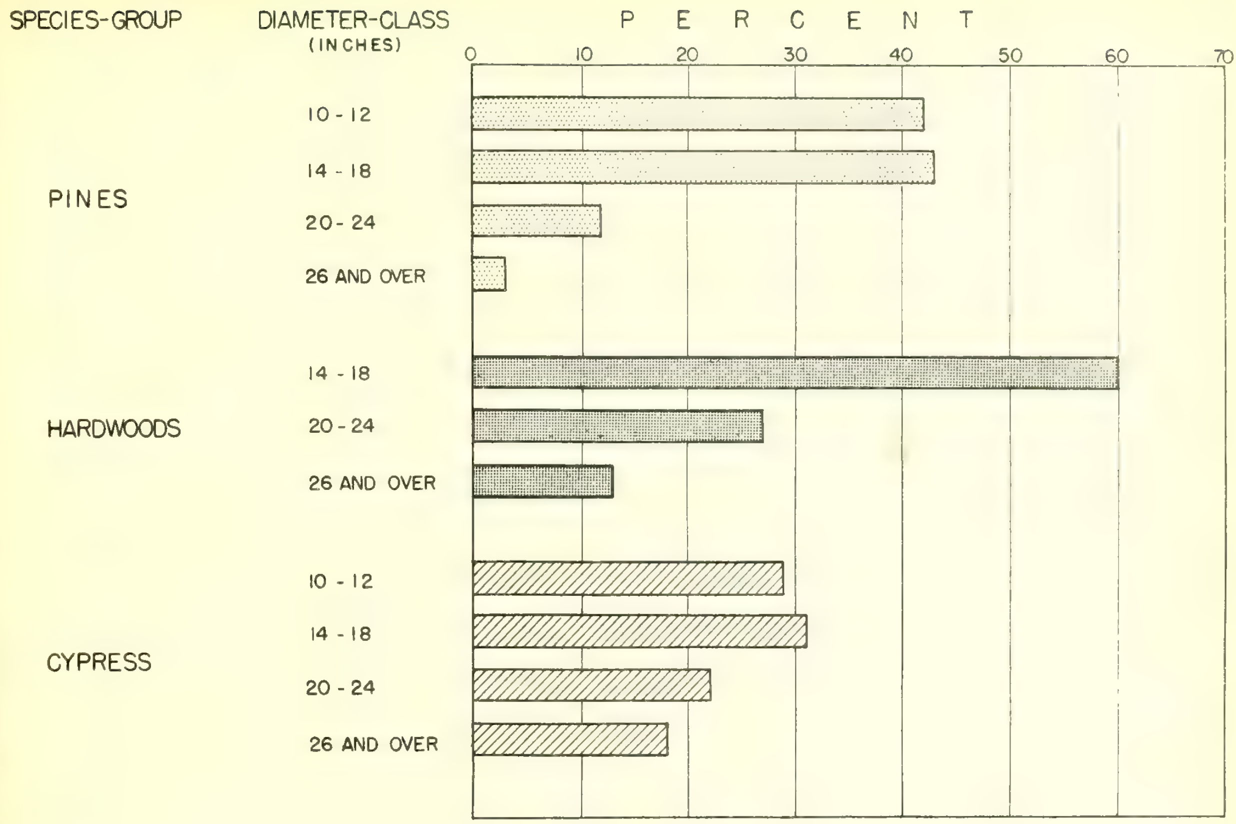
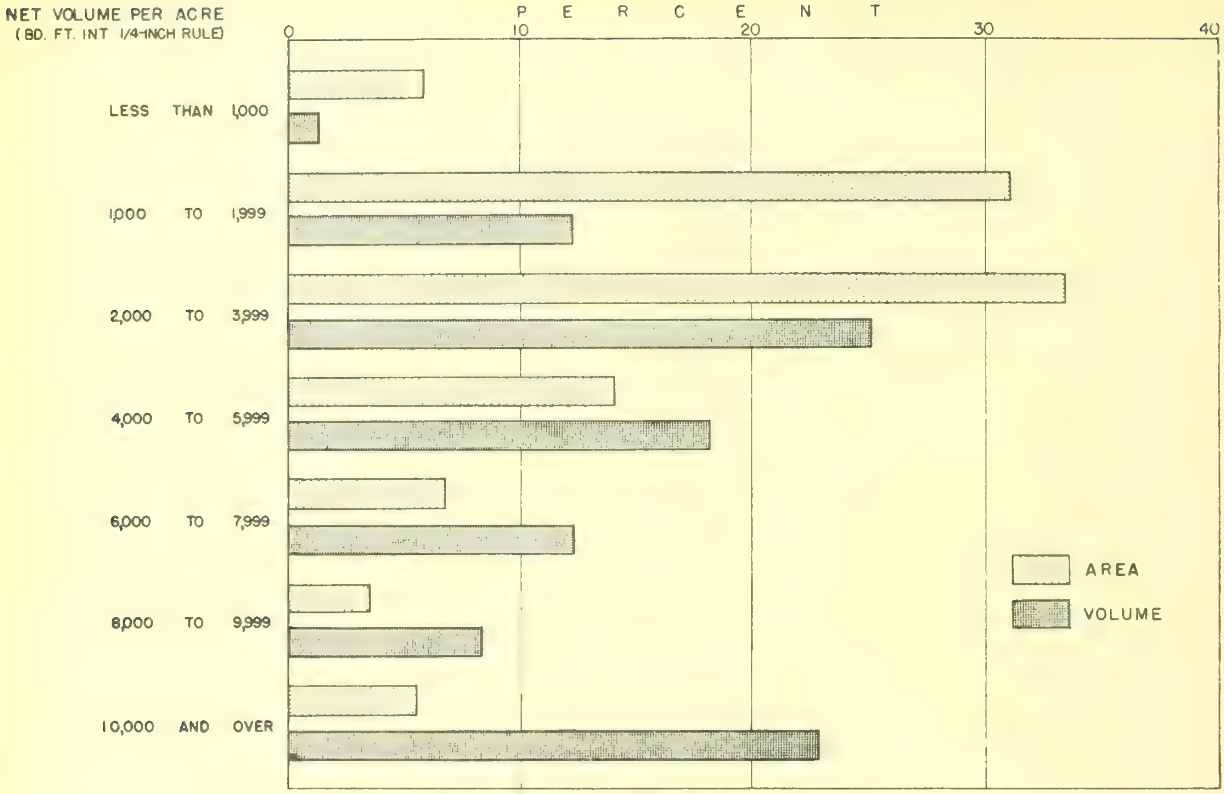


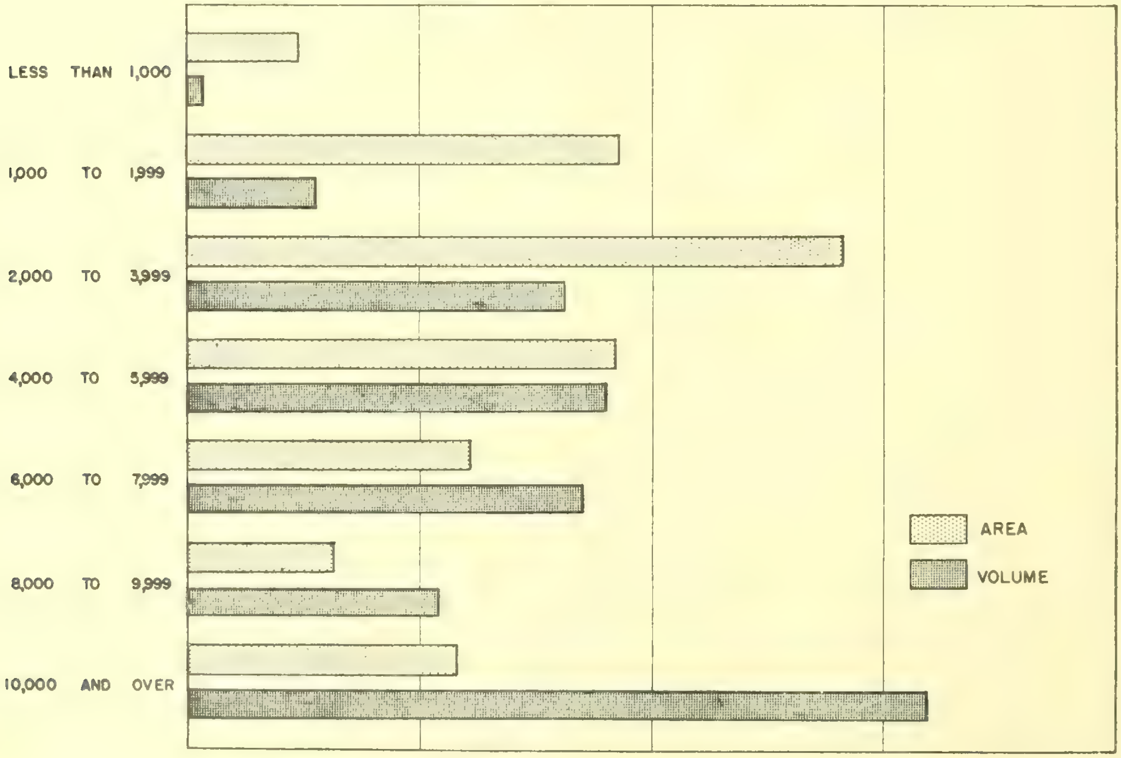
FIGURE 3.- DIAMETER DISTRIBUTION OF BOARD-FOOT VOLUME (INTERNATIONAL 1/4-INCH RULE)

A measure of the economic availability of the board-foot volume in the sawlog-size stands is the average volume per acre (fig. 4). The pine and pine-hardwood types (loblolly pine-hardwoods, pond pine-hardwoods, and longleaf pine) occupy 2.1 million acres and contain 7.9 billion board feet. Eighty-seven percent of this volume is in stands of more than 2,000 board feet per acre and 23 percent is in stands of more than 10,000 board feet. Thirty-seven percent of the area is stocked with less than 2,000 feet per acre. This pine area is considerably understocked (table 6) but the degree of understocking on the area as a whole is difficult to estimate without a detailed determination of the age-class distribution. Nearly 30 percent of the area is stocked with stands less than 40 years old; such young stands normally have a rather low board-foot volume and on the basis of table 6 have, on the average, poorer stocking than the older stands.

The sawlog-size stands in the hardwood types (upland and bottom-land hardwoods) occupy 721,000 acres and contain 3.7 billion board feet. Ninety-four percent of the volume is in stands of more than 2,000 board feet per acre and 32 percent is in stands of more than 10,000 board feet. Only one-fourth of the area is stocked with less than 2,000 feet per acre.



A.- PINE AND PINE-HARDWOOD TYPES



B - HARDWOOD TYPES

FIGURE 4.- DISTRIBUTION OF AREA AND BOARD-FOOT VOLUME IN THE SAWLOG-SIZE CONDITIONS, CLASSIFIED ACCORDING TO VOLUME OF SAW TIMBER PER ACRE.

Consideration of the total board-foot volume in the unit, both pine and hardwood, reveals that 84 percent is in sawlog-size stands of more than 2,000 board feet per acre.

A small proportion of the volume in the pond pine pocosins and larger swamps is inaccessible according to present standards. In parts of Green, Holly Shelter, Angola, and White Oak swamps the volume per acre is so low and the physical difficulties so great that logging is not practical. Probably less than 5 percent of the total volume is so situated.

The average board-foot volume per acre, within a given forest condition, varies noticeably by forest type (table 9). In the old-growth uncut condition of the loblolly pine-hardwood type the average stand per acre is nearly 16,000 board feet, in contrast to 3,100 feet in the same condition of the pond pine-hardwoods type. The values given in this table are a useful guide to the average volumes in the different forest types and conditions of this unit. Although not applicable to a small area, these values will give an approximation of the board-foot volume on an extensive acreage if its area composition by forest types and conditions is first roughly determined.

Table 9. - Average board-foot volume per acre classified according to forest type and forest condition, 1937

Forest type	Sawlog size					Under sawlog size[1]	Weighted average of all conditions
	Old growth		Second growth		Weighted average		
	Uncut	Partly cut	Uncut	Partly cut			
	Thousand board feet[2]						
Loblolly pine-hardwoods	15.9	6.2	4.6	2.8	4.3	.3	2.9
Pond pine-hardwoods	3.1	2.5	2.0	2.0	2.3	.2	1.0
Longleaf pine	4.8	3.5	2.2	2.0	2.7	.2	.8
Upland hardwoods	7.5	3.5	1.9	1.7	2.4	.1	.7
Bottomland hardwoods	9.2	6.0	3.6	2.5	5.5	.3	3.7
Average all types	8.5	5.2	3.8	2.7	4.1	.2	2.2

[1] Includes reproduction, and clear-cut areas.

[2] Net volume (International $\frac{1}{4}$-inch rule).

Cordwood Volume[2]

The net volume of sound material in all living trees 5.0 inches d.b.h. and larger, is 66.7 million standard cords (table 10). In the pines, nearly three-fourths of the volume is in sawlog-size trees. The 4.5 million cords in the upper stems of these larger trees is generally suitable for pulpwood when mixed with other better-quality material, but of course will not become available until the trees are felled for the saw-timber portion of the bole. Some part of the 7 million cords in sound pine trees under sawlog size should be removed in thinning operations, but the majority of these smaller trees should be left in the stand to contribute to the saw-timber growing stock. Allowing these smaller trees to grow to sawlog size builds up the supply of timber for the lumber industry, provides a more economical supply of wood for the pulpwood industry, and allows the timber owner to benefit from the rapid increase in volume and value made by stands in the early stages of merchantability. Although there are 1.3 million cords of sound material in cull pine trees, it will be utilized only in conjunction with pulpwood or fuelwood cuttings in better quality material, because of the scattered distribution of these cull trees.

Table 10. - Net cordwood volume of all sound material, 1937

Species-group	Source of material				Total	Proportion of total
	Sawlog-size trees		Sound trees under sawlog size	Cull trees		
	Sawlog material	Upper stems				
	- - - - - -	- - - - - -	Cords	- - - - - -	- - - - - -	Percent
Pines:						
Loblolly	14,779,400	3,194,500	4,366,200	549,700	22,889,800	34.3
Pond	2,402,200	704,900	1,104,700	653,900	4,865,700	7.3
Longleaf	1,934,400	421,200	975,800	95,500	3,426,900	5.1
Shortleaf	607,200	144,500	515,800	21,700	1,289,200	1.9
Total pines	19,723,200	4,465,100	6,962,500	1,320,800	32,471,600	48.6
Hardwoods:						
Black gums	3,232,500	1,640,200	4,166,200	2,737,900	11,776,800	17.6
Red gum	2,017,400	1,155,200	1,812,900	643,800	5,629,300	8.4
Yellow poplar	532,500	304,000	355,200	193,000	1,384,700	2.1
Red oaks	1,134,500	580,200	1,090,000	866,600	3,671,300	5.5
White oaks	435,300	227,800	1,061,400	334,600	2,059,100	3.1
Other hdwds.	1,311,400	668,700	2,642,000	3,133,700[1]	7,755,800	11.7
Total hdwds.	8,663,600	4,576,100	11,127,700	7,909,600	32,277,000	48.4
Cypress	1,108,700	299,000	370,900	207,200	1,985,800	3.0
Total all species	29,495,500	9,340,200	18,461,100	9,437,600	66,734,400	100.0
Percent of total	44.2	14.0	27.7	14.1	100.0	

[1] Includes scrub oak and non-commercial species.

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[2] See glossary for description of material included in cordwood volume.

About three-fifths of the hardwood volume is in cull trees and sound trees below sawlog size. The discussion of the pine volume above, applies in general to the hardwoods, with the exception that cull hardwoods sometimes make up enough volume in a specific locality to warrant utilization. This is particularly true of the black and tupelo gums where many of the trees have too much sweep to be classed as saw timber, but are entirely satisfactory for pulpwood. Nearly one-fourth of the volume in these species is in cull trees.

The distribution of the net cordwood volume among the several tree diameter-classes is presented in table 11. The volume of 52.4 million cords shown here does not include the sound volume in cull trees (9.4 million cords) or the volume in upper-stems and limbs of sawlog-size hardwoods and cypress (4.9 million cords). Fifty-eight percent of the total volume is in trees 5.0 to 13.0 inches in diameter. These small trees are the best size for pulpwood but a large proportion of them must be left to meet future needs for saw timber and other higher quality products.

Table 11. - Net cordwood volume of sound trees classified according to species-group and diameter-class, 1937

Species-group	Tree diameter-class (inches)				Total	Proportion of total
	6 - 8	10 - 12	14 - 18	20 and over		
	Cords (bark included)					Percent
Pines:						
Loblolly	4,366,200	8,341,300	7,326,100	2,306,500	22,340,100	42.6
Pond	1,104,700	1,758,200	1,216,000	132,900	4,211,800	8.0
Longleaf	975,800	1,091,800	1,000,100	263,700	3,331,400	6.4
Shortleaf	515,800	537,100	153,700	60,900	1,267,500	2.4
Total pines	6,962,500	11,728,400	9,695,900	2,764,000	31,150,800	59.4
Hardwoods:						
Black gums	1,639,600	2,526,600	2,011,200	1,221,300	7,398,700	14.1
Red gum	791,700	1,021,200	1,337,000	680,400	3,830,300	7.3
Yellow poplar	128,400	226,800	376,500	156,000	887,700	1.7
Red oaks	482,000	608,000	557,200	577,300	2,224,500	4.3
White oaks	508,800	552,600	232,400	202,900	1,496,700	2.9
Other hdwds.	1,301,600	1,323,800	1,011,000	317,000	3,953,400	7.5
Total hdwds.	4,852,100	6,259,000	5,525,300	3,154,900	19,791,300	37.8
Cypress	370,900	360,000	379,000	382,800	1,492,700	2.8
Total all species	12,185,500	18,347,400	15,600,200	6,301,700	52,434,800	100.0
Percent of total	23.2	35.0	29.8	12.0	100.0	

The average stand of cordwood per acre in sound trees (excluding cull trees and upper stems and limbs of sawlog-size hardwoods and cypress) is 9.5 cords (table 12). This average includes the light stands in the clear-cut, reproduction, and under-sawlog-size conditions, and is not a good criterion of the volume in sawlog-size stands. In the sawlog-size conditions the average stand per acre varies from 12 cords in partly-cut second growth to 27 cords in uncut old growth. The saw-timber stands in the loblolly pine-hardwoods type, occupying nearly 30 percent of the forest land, have the largest volumes of pine cordwood per acre, while the heaviest concentration of hardwood occurs in the sawlog-size conditions of the bottomland hardwoods type.

Table 12. - Average cordwood volume per acre, classified according to forest type and forest condition, 1937

Forest type	Sawlog size					Under sawlog size[1]	Weighted average of all conditions
	Old growth		Second growth		Weighted average		
	Uncut	Partly cut	Uncut	Partly cut			
	Cords						
Loblolly pine-hardwoods	42.5	18.9	18.0	12.0	16.2	3.2	11.8
Pond pine-hardwoods	10.5	9.3	8.5	7.7	8.9	1.5	4.2
Longleaf pine	14.4	10.1	10.3	7.9	10.0	1.7	3.7
Upland hardwoods	23.7	13.9	11.9	10.4	12.2	2.4	4.9
Bottomland hardwoods	32.2	23.2	21.0	14.3	23.2	3.9	16.6
Average all types	27.3	18.3	16.1	11.8	16.2	2.4	9.5

[1] Includes under-sawlog-size second growth, reproduction, and clear-cut areas.

Cubic-foot Volumes

The volumes shown in cords in table 10 are summarized in cubic feet in table 13. These cubic-foot volumes are for net sound wood only; bark is not included.

Table 13. - Net volume of all sound material expressed in cubic feet (inside bark), 1937

Species-group	Source of material				Total	Proportion of total
	Sawlog-size trees		Sound trees under sawlog size	Cull trees		
	Sawlog material	Upper stems[1]				
	Thousand cubic feet					Percent
Pines	1,420,240	317,470	457,930	92,720	2,288,360	50.8
Hardwoods	585,060	270,990	706,360	505,920	2,068,330	45.9
Cypress	86,090	18,370	26,550	15,260	146,270	3.3
Total all species	2,091,390	606,830	1,190,840	613,900	4,502,960	100.0
Percent of total	46.5	13.5	26.4	13.6	100.0	

[1] Includes the upper stems of pine and cedar and the upper stems and limbs of hardwoods and cypress.

Poles and Piles

Many of the trees that contribute to the volumes given in previous tables are suitable for poles or piles. A separate tally was made of those trees that would meet the pole and pile specifications. The results are presented in table 14. Approximately 10 percent of the pine trees in the requisite sizes will make poles or piles. These trees occur scattered throughout the forest and a large proportion of them will be cut for lumber, pulpwood, or other uses rather than for poles.

Table 14. - Total number of pine poles and piles, classified according to length and diameter, 1937

D.b.h. of trees (outside bark)	Pole and pile length (feet)					Total	Proportion of total
	20	25	30	35	40 or over		
Inches	Thousand pieces						Percent
7.0 - 8.9	2,730	551	189	--	--	3,470	30.0
9.0 - 10.9	3,013	731	460	145	29	4,378	37.9
11.0 - 12.9	1,001	860	446	163	149	2,619	22.6
13.0 - 14.9	--	310	375	128	143	956	8.3
15.0 - 16.9	--	--	52	45	43	140	1.2
Total	6,744	2,452	1,522	481	364	11,563	100.0
Percent of total	58.3	21.2	13.1	4.2	3.2	100.0	

THE INCREMENT OF THE FOREST

Any commercial forest land-use enterprise, which has for its objective the continuous production of raw material for wood products, must consider its growing stock as forest capital. In this unit, the sound-tree volumes previously described must be so regarded. Under natural conditions this forest capital will increase each year through growth, and this yearly production of wood should serve as a basis for permanent industries. At present most of the forests of this unit are cut with little or no pretense of leaving a growing stock for the continuous production of wood crops, and as a result the quantity of wood produced each year is small compared with the growth potentialities of the soil and climate.

Increment of the Total Stand

The net volume of wood produced by growth of the forest growing stock is termed "forest increment". In tables 15 and 16 the calculations are based upon (1) the growth of the sound trees remaining in the stand, (2) the volume recruited from those sound trees that grew into measurable size during the year, and (3) the volume lost because of the mortality and decay resulting from forest fires, insect damage, disease, wind-throw, and tree competition. The first two items make up the total growth which must be reduced by the volume loss (item 3) in order to obtain net increment. In the various forest conditions there is a wide divergence in the effect of these three elements upon net increment. It is natural, because of old age, tree competition, and the cumulative effects of fire and insect damage, to have a high mortality in the old-growth conditions (figure 5) but the high mortality in the young second-growth hardwoods is somewhat unexpected and is due in part to the death of an occasional large-diametered residual hardwood in these young stands. Although few in number these high-volume trees account for much of the volume of mortality.

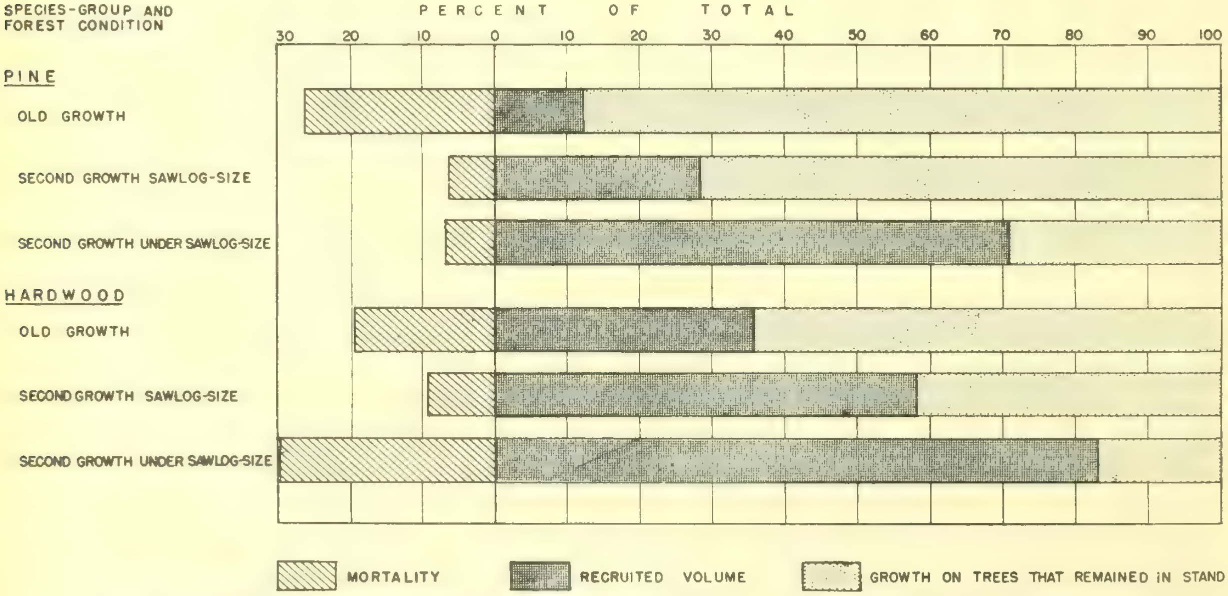

FIGURE 5.-PROPORTIONAL DISTRIBUTION OF THE ELEMENTS OF NET BOARD-FOOT INCREMENT

One of the most interesting features of figure 5 is the high proportion of the total growth recruited from trees reaching sawlog size during the year. This is, of course, most noticeable in the under-sawlog-size conditions but even in the old-growth hardwoods this recruited volume is more than one-third of the total growth; in the whole forest stand it is 38 percent.

In 1937 the total growth was 766 million board feet; from fire and natural causes losses were 77 million board feet, leaving a net increment of 689 million feet (table 15). Old-growth stands contributed about 16 percent of the increment; second growth 84 percent. About 45 percent of the hardwood increment, as compared to only 8 percent of the pine, was in old-growth stands. Nearly one-fifth of the pine increment was in trees located in under-sawlog-size stands, and consequently of rather low saw-timber quality. More than 85 percent of the total cubic-foot increment was in second-growth stands. Although hardwoods produced only 9 percent of the board-foot increment in the under-sawlog-size condition, they made up 19 percent of the cubic-foot increment in the same condition, due chiefly to the wider diameter-range (5.0 to 12.9 inches d.b.h.) in the under-sawlog-size hardwoods.

Table 15. - Net increment in board feet and cubic feet in the various forest conditions, 1937

Forest condition	Saw-timber material			All sound trees[1]		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	Thousand board feet			Thousand cubic feet (i.b.)		
Sawlog size:						
Old growth	41,800	68,300	110,100	7,380	15,240	22,620
Second growth	387,100	76,100	463,200	74,290	24,540	98,830
Under sawlog size:						
Second growth	100,200	9,800	110,000	37,270	8,700	45,970
Reproduction and clearcut	5,200	200	5,400	1,210	150	1,360
Total all conditions	534,300	154,400	688,700	120,150	48,630	168,780

[1] See glossary for detailed description of material included.

The volume of increment is expressed in standard cords in table 16. This material is the same as that shown in cubic feet in table 15, except that bark is included.

Table 16. - Net increment, in cords, of all sound trees in the various forest conditions, 1937

Forest condition	Pine	Hardwood	Total
	Cords[1]		
Sawlog size:			
Old growth	99,000	227,900	326,900
Second growth	1,061,200	378,300	1,439,500
Under sawlog size:			
Second growth	552,900	137,400	690,300
Reproduction and clear-cut	17,500	2,200	19,700
Total all conditions	1,730,600	745,800	2,476,400

[1] See glossary for detailed description of material included.

Increment per acre

The estimate of the average annual increment per acre (table 17) includes the calculated full years growth of the trees harvested during 1937. The values have little direct application to any individual forest property, but they do illustrate the variations in increment between forest conditions, and provide a means of comparing local forest productivity with that of other areas. For instance, the forests of this unit, with an average stocking of 2,210 board feet per acre, are producing an average of 128 board feet per acre compared to 149 board feet in the adjacent coastal plain of South Carolina where the average stocking is 3,300 board feet. The weighted average annual increment per acre does not, however, accurately reflect the increment possibilities of the oncoming second-growth stands. A better measure is the 261 board feet or .78 cords of increment per acre accruing in the second-growth uncut stands. These values can be increased materially as more forest owners accept and practice the principles of forest management.

Table 17. - Average increment per acre by forest conditions, 1937

Forest condition	Saw-timber material			All sound trees	
	Pine	Hardwood	Total	Including bark	Excluding bark
	Board feet			Cords	Cubic feet
Sawlog size:					
Old growth:					
Uncut	57	130	187	.46	32.0
Partly cut	61	78	139	.46	32.0
Second growth:					
Uncut	219	42	261	.78	53.8
Partly cut	146	31	177	.58	39.7
Under sawlog size:					
Second growth	49	5	54	.34	22.8
Reproduction and clear-cut	8	Negl.	8	.03	2.1
Weighted averages	99	29	128	.46	31.2

THE PRIMARY FOREST INDUSTRIES

Primary forest industries are those that obtain their raw material direct from the forest. Important products of these industries in this unit are lumber, fuelwood, poles and piles, crossties, veneer, and pulpwood.

The Lumber Industry

As early as 1750 Wilmington exported longleaf pine lumber to the West Indies and England. The first steam sawmill established at Wilmington was erected in 1818. Lumber production remained at a fairly constant level from 1820 to about 1880, at which time it increased sharply. By 1890 the supply of longleaf pine was rapidly becoming exhausted and loblolly pine, known to the trade as North Carolina pine, assumed a dominant place in the lumber industry. In 1893 there was nearly twice as much lumber cut from loblolly pine as from longleaf pine.[1] At present fully three-fourths of the pine lumber cut in this unit is loblolly.

The present lumber industry is dominated by small portable sawmills (fig. 6), operating chiefly in second-growth timber. Of the 464 mills operating in 1937, only 11 had a sawing capacity of more than 20,000 board feet per day (table 18). Including sawn crossties the total production was 342 million board feet, of which 84 percent was pine, 13 percent mixed hardwoods, and 3 percent cypress (classed with hardwood in table 18). About 75 percent of the pine saw timber and 50 percent of the hardwood were cut from stands of second-growth timber. Hardwood cut by the smaller mills was about 80 percent second growth, while that cut by mills with a capacity of more than 20,000 board feet per day was only 30 percent second growth. Seven million board feet of sawlogs were brought into the unit from the Piedmont and the Coastal Plain counties to the north, but this importation was exceeded by the 33 million board feet of sawlogs shipped from this unit to these outside areas. Sawlogs imported from other states were of negligible amount.

Each size-class of sawmill has certain characteristic features that are summarized in table 18. The data, obtained by interviewing several hundred sawmill operators, reflects only the average situation, which may not apply to specific sawmills. The smaller mills move frequently, averaging a change in location about 4 times a year; one mill moved 19 times in 12 months. Average woods and mill employment in the largest size-class is influenced upward by the presence of 2 mills cutting over 40,000 board feet per day.

It is significant that only 4 sawmill operators reported that they were cutting timber from their own land. This may mean that the lumber industry, having little immediate interest in the future productivity of the forest land being cut-over, will leave large areas in poor condition for future growth. On the other hand, divorcing lumber manufacture from timber growing enables the landowner to concentrate on growing timber at

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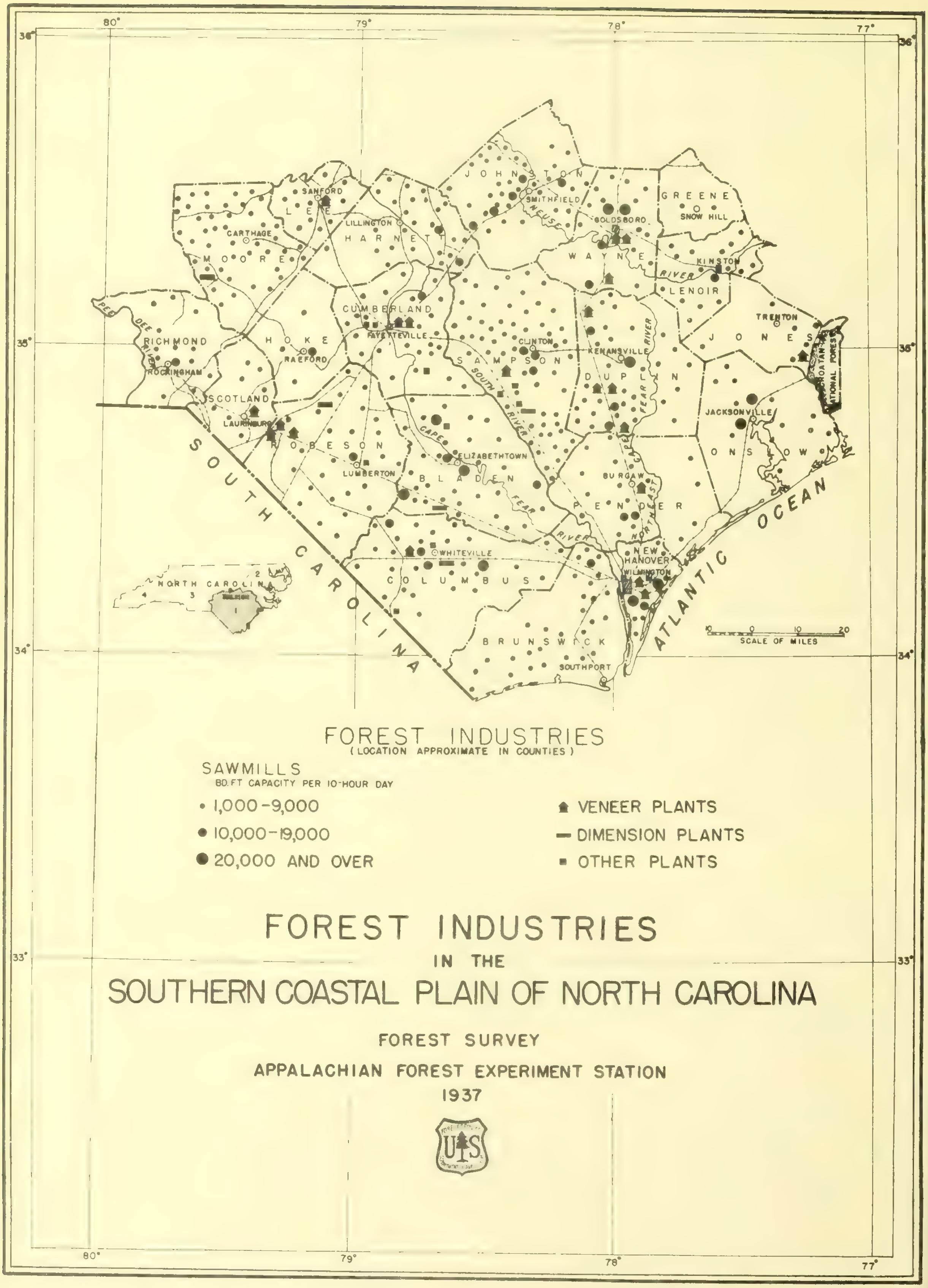
[1] Ashe, W. W.; The Forests, Forest Lands, and Forest Products of Eastern North Carolina. Bul. 5, North Carolina Geological Survey, 1894.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KINSTON
RIVER
LENOIR
SANFORD
LEE
LILLINGTON
HARNETT
CARTHAGE
MOORE
CUMBERLAND
FAYETTEVILLE
PEE DEE RIVER
RICHMOND
ROCKINGHAM
HOKE
RAEFORD
SCOTLAND
LAURINBURG
ROBESON
LUMBERTON
CLINTON
SAMPSON
SOUTH RIVER
KENANSVILLE
DUPLIN
CAPE FEAR RIVER
NORTHEAST CAPE FEAR RIVER
TRENTON
JONES
CROATAN NATIONAL FOREST
JACKSONVILLE
ONSLOW
ELIZABETHTOWN
BLADEN
BURGAW
PENDER
NEW HANOVER
WILMINGTON
WHITEVILLE
COLUMBUS
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SCALE OF MILES
FOREST INDUSTRIES
(LOCATION APPROXIMATE IN COUNTIES)
SAWMILLS
BD. FT CAPACITY PER 10-HOUR DAY
• 1,000-9,000
● 10,000-19,000
● 20,000 AND OVER
VENEER PLANTS
— DIMENSION PLANTS
▪ OTHER PLANTS
FOREST INDUSTRIES
IN THE
SOUTHERN COASTAL PLAIN OF NORTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1937

Figure 6

a profit without being burdened by the financial complexities of operating a profitable sawmill. Having smaller overhead costs the timber grower is in a better position to hold his timber for sustained yield, and to sell it when market conditions are most favorable.

Table 18. - Descriptive summary of lumber production in sawmills of various size-classes, 1937

Item	Capacity in thousand board feet per 10-hour day			All mills
	1 - 9	10 - 19	20 and over	
Number of sawmills	424	29	11	464
Avg. 1937 production per mill (M bd.ft.)	490	2,250	6,045	736
Total production of pine (M bd.ft.)	194,000	51,300	41,300	286,600
Total production of hardwood (M bd.ft.)	15,800	14,000	25,200	55,000
Total production all species (M bd.ft.)	209,800	65,300	66,500	341,600
Avg. number of days worked per mill	210	250	235	213
Avg. number of men per sawmill operation	7	23	95	10
Avg. number of men per woods operation	6	11	55	7
Percent of mills using:				
Circular saws	100	93	30	98
Band saws	--	7	70	2
Resaws	--	25	70	3
Edgers	60	100	100	63
Planers	5	79	70	11
Dry kilns	--	67	70	6

Other Forest Industries

The furniture industry of North Carolina has created a local market for furniture veneers. Ten plants in this unit made furniture veneer and plywood in 1937 (table 19). They used about 36 million board feet of high-quality material, mostly red and black gum, and yellow poplar. Eighty percent of the volume was cut from old-growth stands and the bolts used averaged about 18 inches in diameter. Practically all of the plants bought their wood delivered at the mill yard, but one company responsible for about half the production purchased stumpage and logged it with their own woods crew. The product is veneer or 3 and 5-ply panels, usually measured in "panel feet" i.e. square-foot surface measure. About 1,200 men were employed at the 10 plants in 1937, and approximately 165 million panel feet of veneer were produced.

Marketing the berries and truck crops raised throughout the unit requires a great number of crates and baskets. Over 17 million board feet of material were used by the 10 local plants making single-ply crate and basket veneers in 1937. Gum, pine, and yellow poplar are the chief species used. All of the pine and about half of the hardwood were cut from second-growth stands. About two-thirds of the wood was bought delivered at the plant, the rest was purchased as stumpage. The plants normally employ about 500 men but during the vegetable shipping season additional workers are engaged to fabricate baskets and crates.

Five plants were engaged in the production of hardwood blanks for the furniture trade. They used nearly 8 million board feet of hardwood, practically all black and tupelo gum. About 70 percent of it was taken from second-growth stands. One plant logs its own timber, and the rest buy logs delivered at the mill. About 125 men were employed in the 5 plants operating an average of 300 days each in 1937.

The remaining primary forest industrial plants include 8 shingle mills, 1 box factory, and 2 turpentine stills. The shingle mills are small portable affairs, employing an average of about 5 men. Their output of white cedar, cypress, and pine shingles is used locally. The box factory, using pine and black and tupelo gum, is relatively stationary. About 3 million board feet of timber were cut for the shingle mills and box factory. The 2 turpentine stills were located in Sampson and New Hanover Counties, respectively. They produced about 785 units of naval stores in the 1937-38 season. At present there are no pulp mills operating or under construction in this unit, but a pulp company has purchased a plant location and about 135,000 acres of timberland near Acme in Columbus County. A small quantity of pine pulpwood was shipped outside the unit to mills of the West Virginia Pulp and Paper Company.

A large volume of wood is removed from the forest each year in the form of cross ties, poles and piles, fuelwood, and fenceposts. Of the 270,000 hewn ties cut in 1937, 25 percent were pine, 24 percent were cypress, and 51 percent were hardwood, chiefly red and white oak. Common-carrier railroads purchased 73 percent of the ties, 15 percent were used directly by logging railroads, and 12 percent were purchased by wood-preserving plants. Practically all of the poles and piles were pine, having an average length of 35 feet. Treating plants purchased 99 percent of the production, railroads bought the remainder for local use. Rapid progress in rural electrification has created a local demand for 35-foot class 7 pine poles.

More wood was used for fuel than for lumber in 1937. Over 1.4 million cords of fuelwood were consumed; about 70 percent for heating homes, schools, and small commercial establishments and about 30 percent for curing tobacco. Approximately 604,000 cords were derived from cull trees, sawmill waste, and top-wood of hardwood trees. The removal of cull trees improves the quality and growing condition of the remaining stand, and in view of the large amount of cull timber available (table 10) it would be good forestry to cut an even larger part of the fuelwood requirement from these low-quality trees and save the present or prospective sawtimber for a more profitable use.

It is estimated that 51,000 cords of wood were used on farms for such items as fence posts and tobacco barns. Fencing is infrequent in this unit and most of the posts are made of material nearest at hand, ranging all the way from small pine or gum saplings to good quality split oak or pine, and round cedar posts. A majority of the new tobacco barns are made of lumber but in the more isolated districts new barns of squared logs are often seen.

Employment

Forest labor is utilized both in the production of forest products for sale and in obtaining wood products for home use. Employment in the lumber, veneer, crosstie, pole, and miscellaneous industries, which provides a cash income to the employee, amounted to only 45 percent of the 3.2 million man-days of forest employment (table 19). Workers in the various plants and sawmills were given fairly continuous employment in 1937; as even the smaller sawmills averaged more than 200 days operating time. Many individuals worked full-time getting out sawlogs, veneer blocks, poles, or crossties, but much of this material was produced by farmers between crop seasons. At least 10,000 individuals were commercially employed in the primary forest industries and in view of the part-time forest activity of many farmers it is probable that 15,000 or more received a share of their income from forest work. At 25¢ per hour the total income from forest industrial employment would be 3.6 million dollars.

Table 19. - Production and employment in the primary forest industries, 1937

Kind of plant or commodity	Number of plants	Cut in woods	Produced or used by plants	Employment provided		
				In woods	In plants	Total
		M bd.ft.		Thousand man-days		
Sawmills	464	367,400	341,600	445	561	1,006
Furniture veneer	10	33,700	36,500	63	142	205
Package veneer	10	17,000	17,000	32	66	98
Furniture dimension	5	7,700	7,700	11	27	38
Misc. manufactures[1]	9	4,200[2]	3,000	12	8	20
		M pieces				
Crossties (hewn)	--	270	--	38	--	38
Poles and piles	--	149	--	33	--	33
		Units				
Naval stores	2	--	785	14	1	15
		M cords				
Fuelwood	--	1,433	--	1,720	--	1,720
Misc. farm use	--	51	--	56	--	56
Total	500	--	--	2,424	805	3,229

[1] Includes 8 shingle mills and one box factory.

[2] Includes pulpwood cut from saw-timber trees.

Fifty-five percent of the forest employment was utilized in the production of fuelwood and material for farm maintenance. Comparatively little of the fuelwood was sold commercially to obtain a direct cash income. At $3.00 a cord, however, the fuelwood has a value of 4.3 million dollars, which, after deductions for stumpage and transportation, represents the indirect wage retained by farmers, as they use most of the wood. With 73,000 farm operators depending largely upon home-cut wood for fuel, it is obvious that cutting firewood is a task engaged in by many thousands.

Commodity Drain

The commodity drain from the sound-tree growing stock (table 20) includes both the utilized material and the sound usable material left in felled trees. The drain on the saw-timber portion of the trees, including both the utilized and wasted portions, is expressed in board feet, while the volumes given in cubic feet include drain on saw-timber material, upper stems of sawlog-size pines, and small trees ranging from 5.0 inches d.b.h. up to sawlog size.

About three-fourths of the total saw-timber drain was cut from the pines and one-fourth from the hardwoods. Only 20 percent of the pine was cut from old-growth stands of timber in contrast to nearly 60 percent of the hardwood. Lumber production caused 62 percent of the drain and fuelwood an additional 22 percent. Field observations indicate that there is very little waste in the cutting of sawlogs, particularly in the pine species. Frequently the rough top logs are used for fuelwood, and in some cases the larger limbs are utilized. Although not much wood is left on the ground unused there is need for more discrimination in the use of the various classes of material. Burning 100 million feet of pine saw timber for firewood in one year is scarcely justified in a region where stumpage brings $3.00 to $6.00 per thousand board feet. More of the fuelwood should be cut from the poorer quality second-growth hardwood that threatens to replace the pine on many areas.

Fuelwood constitutes most of the drain on trees below sawlog size. As a consequence the proportion of the cubic-foot drain caused by lumbering drops to 48 percent while the fuelwood drain increases to 38 percent of the total. If part of the fuelwood were not taken from cull trees and sawmill waste the fuelwood drain would exceed the drain caused by lumbering.

Table 20. - Commodity drain from the sound-tree growing stock, 1937

Commodity	Saw-timber material			All sound trees[1]		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	Thousand board feet			Thousand cubic feet		
Lumber	309,100	58,300	367,400	60,730	9,740	70,470
Veneer	3,300	52,000	55,300	650	8,630	9,280
Crossties	3,700	12,400	16,100	720	2,150	2,870
Poles and piles	9,700	100	9,800	1,910	20	1,930
Misc. manufactures	2,300	10,800	13,100	560	1,800	2,360
Fuelwood	102,300	26,000	128,300	36,210	19,390	55,600
Misc. farm use	3,300	2,200	5,500	1,780	1,160	2,940
Total	433,700	161,800	595,500	102,560	42,890	145,450

[1] Total drain from growing stock expressed in cords of wood with bark: pine, 1,439,100; hardwood, 638,900.

COMPARISON OF INCREMENT WITH COMMODITY DRAIN

In this section the interrelations of growth, mortality, net increment and commodity drain are analyzed to determine the status of the forest stand and the possibility of forest industrial expansion.

Comparison in Board Feet

During 1937 the forests of this unit increased in saw-timber volume by 93 million board feet, for, although the commodity drain was large, the net increment was even larger (table 21). This favorable situation is due, in part, to the rapid growth of the second-growth pine stands, particularly those just approaching sawlog size. In the old-growth pine timber the increment is approximately half the drain, in the second-growth sawlog-size stands the increment exceeds the drain by more than enough to make up the deficit in the old-growth condition, while in the under-sawlog-size condition the saw-timber increment is nearly 10 times the drain.

The pine saw-timber drain is chiefly for lumber and a high proportion of it is cut from the larger trees. Although the portable mills often cut too heavily, much of their cutting is in relatively even-aged old-field stands. As timber is not particularly scarce cutting is most frequent in the older, merchantable stands, and decks of very small logs cut from young timber are seldom encountered. In view of the large area of young pines that is rapidly reaching saw-timber size, the surplus of increment in 1937, and the reported reduction in lumber cut in 1938, it appears that the pine growing stock can continue to meet the demands made upon it, on a sustained yield basis, provided there is no radical increase in the forest industries. Furthermore, if the drain does not greatly increase in the next 10 to 15 years, the constantly augmented growing stock will then produce an annual increment sufficient to justify an expansion of the wood-using industries.

The relation of increment and drain in the hardwood species, including cypress, cannot be judged correctly by the 7 million board feet reduction in growing stock in 1937. The deficit was entirely in cypress, as the cut of this species was more than twice the increment. It is, however, good forestry practice to cut the mature old-growth cypress and as second growth is limited in quantity and low in growth rate there is little justification for expecting to have a balanced cypress budget.

Increment of the remaining hardwoods was 4 million board feet more than the drain, a surplus too small to be significant. Of far greater importance is the fact that drain is confined to a relatively few species while increment occurred in all species. Also about half of the hardwood was cut from old-growth stands, a drain of high-grade material that was twice the increment accumulating on old-growth trees of similar quality. The result is an overcut of certain species (ash, white oak, swamp red oak, yellow poplar, old-growth red gum) and grades of hardwood, leaving an increasing proportion of the less valuable species (willow oak, water oak, post oak, bay, black gum) and poorer quality trees. The prospect of an increased supply of high-quality hardwood saw timber is not bright and it is probable that the larger sawmills will gradually shift to pine as good hardwood becomes scarce. The smaller mills probably will cut an increasing amount of low-grade hardwood and the veneer plants will turn increasingly to black gum, the most abundant hardwood in the unit. As these changes will be gradual the effect upon the forest industrial organization will probably be slight.

Table 21. - Balance between increment and drain of saw-timber material, 1937

Item	Pine	Hardwood[1]	Total
	- - - - Thousand board feet	- - - -	
Net growing stock, Jan. 1, 1937	8,452,500	3,808,500	12,261,000
Growth, 1937	583,000	182,900	765,900
Mortality, 1937	48,700	28,500	77,200
Net increment, 1937	534,300	154,400	688,700
Commodity drain, 1937	433,700	161,800	595,500
Net change in growing stock, 1937	+100,600	-7,400	+93,200
Net growing stock, Jan. 1, 1938	8,553,100	3,801,100	12,354,200

[1] Includes cypress.

Comparison in Cubic Feet

Increment in the sound growing-stock trees 5.0 inches d.b.h. and larger was 23 million cubic feet more than the commodity drain, resulting in nearly a one percent increase in the growing stock in 1937 (table 22). Considering the volume of growing stock, the increment, and the commodity drain, it appears that the cubic volume inside bark of sound pine is increasing nearly twice as fast as is the sound volume of hardwood. The influx of many cull hardwoods on cutover pine land is, however, a silvicultural problem that must be solved if pine is to maintain its present position in the support of industry.

Table 22. - Balance between increment and drain of all sound material, 1937

Item	Pine	Hardwood	Total
	- - - Thousand cubic feet (i.b.) - - -		
Net growing stock, Jan. 1, 1937	2,195,640	1,405,060	3,600,700
Growth, 1937	135,680	59,580	195,260
Mortality, 1937	15,530	10,950	26,480
Net increment, 1937	120,150	48,630	168,780
Commodity drain, 1937	102,560	42,890	145,450
Net change in growing stock, 1937	+17,590	+5,740	+23,330
Net growing stock, Jan. 1, 1938	2,213,230	1,410,800	3,624,030

Comparison in Cords

Figure 7 provides a comparison of interest to the cordwood industries. Increment is not indicated but the figure shows that after commodity and mortality drain were deducted from growth there were about 300,000 cords of pine and 100,000 cords of hardwoods left to increase the growing stock. This is enough surplus to supply at least a medium-sized pulp mill without depleting the growing stock or jeopardizing the continued existence of the present industries. Also, in theory, a pulpmill would provide a market for thinnings and low-grade top logs that is almost essential for intensive forestry. In particular, a mill is needed to utilize the large volume of second growth and sound cull black and tupelo gum. In order to insure a permanent supply of raw material any pulp mill developed should own and manage enough forest land to supply a major share of their requirements, and follow good cutting practices upon other privately owned land.

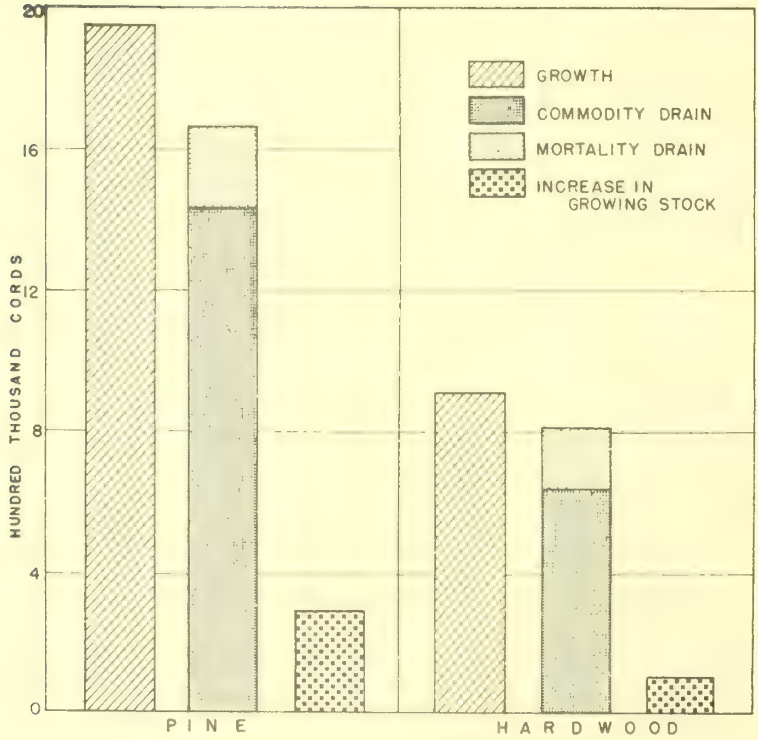

FIGURE 7.- COMPARISON OF GROWTH WITH MORTALITY AND COMMODITY DRAIN, 1937

FOREST PROBLEMS AND ACTION NEEDED

In its present condition the forest is producing enough wood to meet domestic needs and supply the requirements of the wood-using industries. The surplus is small, however, and a material increase in timber use will cause the forest resource to decrease. In view of this unit's accessibility to the markets of the East, its existing industrial organization, and its growing population, it is reasonable to assume that an increasing amount of wood will be cut. An increased cut on a sound basis is desirable for economic and social reasons, but before it can be realized several major forest problems must be solved.

Deficiency of Growing Stock

Since the prerequisite for a larger cut is a greater increment, it will be necessary to increase the volume of growing stock. Under existing conditions the sound-tree growing stock has not completely utilized the growing space and the annual yield of wood is less than the site potentiality. It is estimated that there is an opportunity to increase the volume of growing stock for the entire unit by at least one-half, with an accompanying increase in annual increment. Building up the growing stock will be a slow process, attainable only through the adoption of better forest practices by the individual land owners. These practices call for prevention of forest fires, cutting methods to insure adequate restocking, thinnings in dense young stands, interplanting in forest openings, planting of abandoned fields and clear-cut areas where they will not restock naturally, and restriction of the cut to about three-fourths of the annual increment until the forest approaches full stocking. Their general acceptance depends upon the ability of forestry agencies to: (1) prove that such practices are financially attractive, and (2) inform the thousands of landowners of the proper forest management technique.

Methods of Cutting

The pine species are the basis for most of the forest industry in the unit. Their wide distribution, adaptability to manufacture, and universal use make them an almost essential component of the forest stand. Nearly 70 percent of the present saw-timber volume and 60 percent of the cordwood volume in sound trees is pine. The emphasis placed upon its utilization and the increasing effectiveness of fire protection have, however, created a problem with far-reaching potentialities. Many of the stands of second-growth pine have a dense understory of small hardwood trees and shrubs. When the pines are removed these hardwoods occupy the land, and may effectively prevent the establishment of pine for many years. Although there is no lack of pine at the present time some foresters and timberland owners believe that hardwoods will gradually replace the pines unless changes in cutting methods are adopted.

More research is needed to determine the best methods of handling the timberlands, particularly loblolly pine, in the Coastal Plain of North Carolina. Conditions here are not entirely similar to conditions in the Deep South where selective cutting has been found a satisfactory way of harvesting mature stands of loblolly pine. In the Coastal Plain of North Carolina many young pine stands are thinned for pulpwood, poles, or small saw timber, a practice that is often referred to as selective cutting. Such thinning is a desirable intermediate step in the management cycle of the stand. It is entirely practical and is applicable to large areas in the pine types. The selective cutting method in which more research is needed deals, however, with the process of selectively harvesting mature stands of saw timber in a manner that will insure a new stand of second growth. The limited amount of experimental selective cutting so far conducted in the Coastal Plain has not yielded very favorable results. To date, clear-cutting with seed trees has most satisfactorily restocked the ground to loblolly pine. It must be emphasized, however, that studies of both clear and selective cutting have been inconclusive and these, as well as other methods, need much more investigation before the problem can be considered solved.

Utilization of Hardwoods

Certain of the better-quality hardwoods are being utilized for lumber and veneer, but there is a great quantity of black and tupelo gum that is less suitable for such use. In these species there are nearly 3 million cords in cull trees alone, and the total sound volume of 12 million cords is 18 percent of the cordwood volume in the unit. Such a large part of the resource must not be neglected in any program of increased forest use, but the ways and means of profitable utilization present a problem. The existing mills can use only a small part of the available volume so it will be necessary to interest new industries. As a suggestion, Wilmington is a favorable location for a hardwood pulpmill, from the standpoint of wood supply, transportation of wood to the plant, and seaport facilities.

The Portable Sawmills

It has become almost a custom to blame forest devastation upon the portable sawmill operator. Unfortunately, much of this criticism is deserved and in certain parts of the South the portable mills have cleared the land of all worth-while saw timber. In this unit, as elsewhere, they often strip the land and leave it in poor condition for future growth. With no proprietary interest in forest land they are uninterested in cutting methods that will assure a new crop of timber. Engaged largely in intrastate business, they supply the local market with cheap lumber produced without the restrictions of the Wage and Hour Law, and thus destroy the local markets of the larger, more stable operations whose production costs are higher because of this law. Furthermore, the portable mills possess a flexibility that enables them to shut down when the market is bad, and to flood the market with lumber when times are good, thus reducing the average annual income of the more permanent operations.

What to do about the portable sawmills? For the present they serve a useful purpose in providing a market for the timber held in small tracts by thousands of owners. They also give employment to several thousand workers, and distribute this employment throughout every county of the unit. In the long run, however, a more stable form of sawmill organization should be developed. This is a difficult task. Some improvement may be obtained by demonstrating the advantages of conservative cutting to the small mill operators. Essentially, however, it is a matter of convincing the forest land owners that sustained-yield forestry will pay and that lump-sum sales to portable mills are against their best interests. Groups of individual land owners managing their woodlands to produce an annual crop of timber can usually interest a larger mill in providing a market. The community and region will benefit through permanent industries, more complete processing, more employment at higher wages, a definite wood market, and a more stabilized basis for forest management.

Fire Control

The risk of fire is a serious obstacle to the practice of forestry and the destruction caused by forest fires is an important source of loss. Both of these factors are operative in preventing greater yields of forest crops in this unit. Increasingly effective protection from fires is being obtained through the efforts of the North Carolina Division of Forestry and the United States Forest Service. As of June 30, 1938, eight private protective associations and all the counties except New Hanover were cooperating in the fire control program. The technique of fire control is undergoing constant improvement but inadequate financing precludes entirely satisfactory protection. In the fiscal year 1937-38 the direct state appropriation for fire control in the state was only $38,000 while the estimated damage from forest fires on non-federal lands in 1938 was $470,000. The framework for intensive fire control already exists over this unit, but the available funds for each protected acre approximated only 1.2 cents in 1937, whereas adequate and efficient fire protection costs about 4.6[1] cents per acre per year. Increased appropriations for fire control are badly needed, and the responsibility for providing them rests heavily upon the State and Federal Governments, as well as upon the private owner.

Taxation

The development of full forest productivity is retarded by the method of taxing forest property. In brief, the general property tax, as applied in this unit, discriminates against forest owners at the two crucial points in the development of the stand; i.e., when the newly cutover land has no immediate prospect of revenue and when the young stand is approaching saw-timber size. Over-assessment in the first case causes some land-owners to give up the idea of growing timber as a profitable business and reassessment at a sharply increased value in the second case may cause owners to dispose of their timber prematurely.

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[1] North Carolina Department of Conservation and Development, 7th Bien. Rept., June 30, 1938.

Defective administration of the general property tax causes wide variation in the assessment of similar land classes, and leads to confusion and discouragement among land owners. For instance, in Cumberland County in 1937 the average assessed value of cut-over land in one township was $2.97 while cut-over land in another township was assessed at $10.10. Irregularities such as this coupled with unpredictable assessment policies are distinctly unfavorable to sustained-yield management for forest properties.

Full discussion of the tax problem is outside the scope of this report. Nelson2/ after making a study of taxation of forest property in North Carolina, suggests that improvement of assessment administration holds promise of greatest and most immediate benefit; secured through the employment of expert full-time assessors, acting under state supervision.

2/Nelson, R. W., Taxation of Forest Property in North Carolina, Forest Taxation Inquiry, U. S. Forest Service.

SUMMARY

Since early colonial days the forest resource has been an important factor in the economic life of this region. More than 2 centuries of unrestricted use have caused many changes in the forest growing stock but the present-day forest is nevertheless an important source of raw material for domestic and industrial use. Agriculture is now the dominant industry, but forests occupy two-thirds of all the land.

The forest is distributed throughout the unit but there is a higher proportion of wooded land in the Tidewater counties. Pine types occupy three-fourths of the forest area, with loblolly pine the most abundant species. Nearly ninety percent of the forest is second growth, with most of the stands less than 75 years old. About half of the stand is saw-timber size, 47 percent is under sawlog size, and 2 percent is clear-cut. The total saw-timber volume is 12.3 billion board feet; two-thirds pine and one-third hardwoods. There are 66.7 million standard cords of wood with bark or 4.5 billion cubic feet of wood only. Increment amounted to 689 million board feet, 2.5 million cords, or 169 million cubic feet.

At least 464 sawmills operated in 1937, 424 of which had a capacity of less than 10,000 board feet per day. Veneer for furniture and package stock was produced by 20 plants and ranked after lumber in commercial importance. About 1.4 million cords of fuelwood were used in 1937; chiefly on farms. These, and other forest activities, provided 3.2 million man-days of employment which returned a cash income to at least 10,000 workers. The commodity drain amounted to about 596 million board feet of saw timber or 145 million cubic feet of all sound material. Increment was greater than drain, so that the forest growing stock increased by 93 million board feet, or 23 million cubic feet.

The relation of increment to forest depletion is reasonably satisfactory. There is a large and active forest industry and, broadly speaking, the timber resource is increasing faster than it is being used. Nearly half of the forest is young second growth that will increase the supply of saw timber at a very rapid rate during the next decade. This development of small trees into saw-timber sizes will, however, further reduce the quality of the board-foot volume, making it necessary to import high-quality timber requirements from other regions. Unless radical change occurs in the agricultural situation more than half of the land will continue to be used for timber production. Full use of this forest land will require education of land owners, research in timber management, promotion of specific industries, more intensive fire control, and revision of the tax structure. As the effects of these measures become apparent in greater yields of wood a gradual expansion of forest industry will be justified.

GLOSSARY

General

Forest survey unit. -- The term "forest survey unit" denotes an area of 4 to 10 million acres in which topographic, forest, economic, and industrial conditions are reasonably homogeneous.

Land-use Classes

Productive forest area. -- Forest land having qualities essential for the growth of commercial timber.

Non-productive forest area. -- Forest land lacking qualities essential for the growth of commercial timber.

Cropland, old and new. -- Land used for production of farm or orchard crops or evidently so used during the last 5 years. This includes new cropland, i.e., land converted from forest to cropland within 5 years prior to survey.

Pasture. -- Cleared or open land under fence used primarily for grazing.

Abandoned cropland. -- Land once cultivated but showing distinct evidence of having been abandoned for agricultural crop production. Restocking to timber has not yet occurred.

Other non-forest. -- Areas included within the corporate limits and surburban or industrial sections of cities and communities; power, rail, and highway rights-of-way; marsh; and non-meandered waterways.

Forest Types

Loblolly pine-hardwoods. -- Stands in which pines make up 25 percent or more of the dominant and codominant stems with loblolly pine predominating.

Pond pine-hardwoods. -- Stands in which pines make up 25 percent or more of the dominant and codominant stems with pond pine predominating.

Longleaf pine. -- Stands in which pines made up 25 percent or more of the dominant and codominant stems with longleaf pine predominating.

Upland hardwoods. -- Stands in which mixed oaks and other hardwoods make up 75 percent or more of the dominant and codominant stems, usually found on the rolling upland sites.

Bottomland hardwoods. -- Stands in which hardwoods make up 75 percent or more of the dominant and codominant stems, usually found in river bottoms.

Diameters

D.b.h. (diameter at breast height). -- Diameter, outside of bark, measured at 4½ feet from the ground.

Diameter class. -- All trees were recorded in 2-inch diameter classes, including diameters 1.0 inch below and 0.9 above the stated midpoint, e.g., trees 7.0 to 8.9 inches d.b.h. are placed in the 8-inch class.

Tree Classification

Sound sawlog-size tree. -- A pine, cypress, or cedar tree at least 9.0 inches d.b.h., or a hardwood tree at least 13.0 inches d.b.h., with not less than one sound butt log 12 feet long, or with 50 percent of the gross volume of the tree in sound sawtimber.

Sound under sawlog-size tree. -- Any tree over 1.0 inch d.b.h. and less than sawlog-size, at least 75 percent sound with a reasonably straight stem.

Cull tree. -- Any tree that fails to qualify as a sound sawlog or under-sawlog-size tree because of form, limbiness, rot, or other defect.

Pole or pile tree. -- A pine tree that will produce a pole or pile conforming to pole specifications of the American Standards Association.

Forest Conditions

Sawlog Size

Old growth, uncut. -- Stands composed of trees having the characteristics of the original mature timber of the region and containing at least 1,000 board feet per acre of merchantable species in hardwood types, and 600 board feet per acre in pine types, with less than 10 percent of the volume cut.

Old growth, partly cut. -- Old-growth stands from which 10 percent or more of the volume has been cut, leaving a minimum of 1,000 board feet per acre in the hardwood types, or 600 board feet per acre in the pine types.

Second growth, uncut. -- Stands of second growth having at least 600 board feet per acre in trees of sawlog-size, and with less than 10 percent of the sawlog-size trees removed.

Second growth, partly cut. -- Stands of second growth from which 10 percent or more of the sawlog-size trees have been removed but with the remaining stand containing 600 or more board feet per acre.

Under Sawlog Size

Second growth. -- Young second-growth stands in which the volume of timber in trees of sawlog size is less than 600 board feet per acre and the remainder of the trees are below sawlog size.

Reproduction. -- Stands too young to classify as second growth, having at least 80 well-distributed seedlings per acre.

Clear-cut. -- Cut-over areas having insufficient young growth to qualify either as second growth or reproduction.

Volume Estimates

Board-foot volume. -- Only the saw-timber portion of sawlog-size trees are included in this estimate. Top diameters vary with the limits of usable material. Deductions are made for woods cull and for loss in sawing at the mill.

Cordwood volume. -- This volume (including bark) is derived from the following sources:

1. The sawlog portion of sawlog-size trees.

2. The portion of saw-timber trees not usable as sawlogs but acceptable as cordwood. This includes the upper stems of pine and cedar and, unless otherwise noted, the upper stems and limbs of hardwoods and cypress. The minimum diameter limit is 4.0 inches outside bark.

3. The full stem of sound under-sawlog-size trees, at least 5.0 inches d.b.h., to a variable top diameter not less than 4.0 inches outside bark.

4. The estimated sound material in cull trees.

Deductions for cull include only the volume in defects which cause the material to be unsuited for cordwood. Sweep and slight crook are not regarded as defects.

Standard cord. -- A stacked pile of round or split wood bolts measuring 4' x 4' x 8' and estimated to contain 90 cubic feet of wood and bark in the pine, cedar, and cypress species, and 80 cubic feet of wood and bark in the hardwood species.

Cubic-foot volume. -- This volume is derived from the same sources as the cordwood volume except that bark is not included.

Increment

Growing stock. -- The sum of the volumes of all sound trees 5.0 inches d.b.h. and larger; dead and cull trees and tops of hardwood and cypress not included.

Board foot increment. -- Includes the net growth on the saw-timber portion of sawlog-size trees, plus the volume in sound trees reaching sawlog-size.

Cordwood increment. -- Includes the net growth on the sound stemwood of pines and cedar 5.0 inches d.b.h. and over, on under sawlog-size hardwoods and cypress, and on the sawlog portion of sawlog-size hardwoods and cypress.

Cubic foot increment. -- Omits bark volumes, otherwise material is identical to cordwood.

Mortality

Mortality. -- The volume lost from the growing stock of the forest through the death of individual trees. Natural causes of mortality include tree competition, old age, disease, insects, drought, and wind. Fire is the major man-caused source of mortality.

13.

CLEMSON COLLEGE

FOREST SURVEY RELEASE NO. 5

JUNE 15, 1940

FOREST RESOURCES OF THE NORTHERN COASTAL PLAIN OF NORTH CAROLINA

by

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A FOREST SURVEY PROGRESS REPORT

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U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

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PREFACE

Through the McSweeny-McNary Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act, and each of the 12 Regional Experiment Stations was made responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station, Asheville, North Carolina.

The work of the Survey is divided into 5 major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of the timber on these lands.

2. Growth. Determination of the current rate of timber growth.

3. Drain. Determination of the amount of industrial and domestic wood use, and the total loss resulting from fire, insects, disease, suppression, and other causes.

4. Requirements. Determination of the current and probable future requirements for forest products by all classes of consumers.

5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis for public and private policies and plans of forest land use and management.

This progress report presents preliminary information on the first three of these phases for the Northern Coastal Plain of North Carolina, one of the 4 units into which the State was divided. A similar release has been published for the Southern Coastal Plain Unit and releases for the Piedmont and Mountain Regions will be published during this calendar year.

Information on the physical forest resources was obtained by a field survey made in the summer and fall of 1937. A total of 8,131 sample plots was established at intervals of one-eighth of a mile on compass lines 10 miles apart, extending across the unit in a northeast direction. The statistical sample obtained from these plot records forms the basis for all area and volume estimates in this report, except where other sources are directly credited. Owing to the method of sampling, small tabular items have the greater probability of error and should be considered as indicating relative magnitude rather than actual values.

Data on consumption of forest products for industrial and domestic purposes were obtained by canvassing all primary manufacturing plants and a number of representative domestic consumers.

Forest Survey Staff Assisting in the Preparation of this Report

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FOREST RESOURCES OF THE NORTHERN COASTAL PLAIN OF NORTH CAROLINA

DESCRIPTION OF THE UNIT

This report describes the forest resources of the northern part of the Coastal Plain of North Carolina. The area, designated by the Forest Survey as North Carolina Unit 2, includes 23 counties containing 6,657,300 acres. It occupies 21 percent of the total area of the State, contains 22 percent of the forest land, and has 17 percent[1] of the State's population.

Agriculture and timber production are the two most important activities. About half of the land is in farms, but forest land, including that on farms, occupies 61 percent of the unit area. Manufacturing is relatively unimportant; the value of products manufactured in 1935 was less than 3 percent of the value of all products manufactured in the State.[2] Most of the people employed in manufacturing were engaged in the textile and wood-using industries.

Physical Conditions

The land surface rises gradually from sea level on the coast to elevations of 300 to 375 feet on the western boundary. The eastern portion of the unit is practically level and is characterized by extensive swamps, shallow lakes, sluggish rivers, and an extremely broken shore-line along Albemarle and Pamlico Sounds. Drainage is poor, most of the run-off going into the Sounds by means of deep sluggish streams. The better-drained soils produce good crops but a large proportion of the soil is swamp or muck that is either too wet or too poor for agriculture. Originally heavily forested, much of the land is now stocked with second-growth timber. This low-lying, flat country has long been called the Tidewater of North Carolina (fig. 1).

The remainder of the unit is referred to in this report as the Western Coastal Plain although it includes a small part of the Piedmont. It differs physically from the Tidewater in that it is higher in elevation with a gently rolling topography, is generally well drained by the Chowan, Roanoke, Tar, and Neuse Rivers, and has soils of good quality for agricultural crops. These favorable natural features, combined with a mild climate, result in an intensive agriculture, centered upon the production of tobacco and cotton. There is a high percentage of forest land, much of which occurs as part of farm properties.

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[1] U. S. Dept. Com., Bur. of the Census, 1930.

[2] U. S. Dept. Com., Consumer Market Data Handbook, 1939.

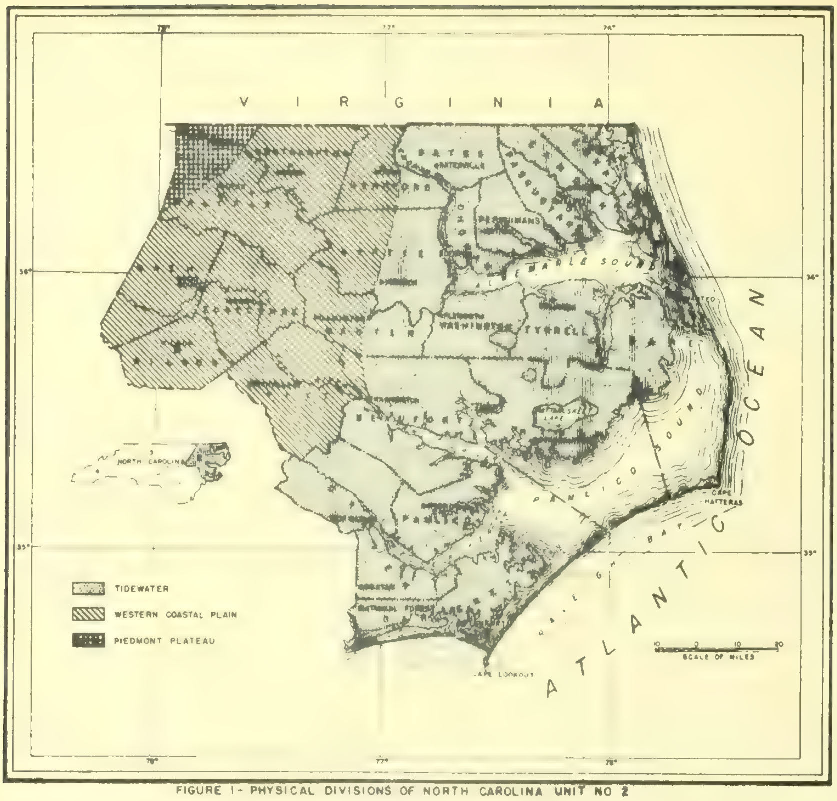

FIGURE 1 - PHYSICAL DIVISIONS OF NORTH CAROLINA UNIT NO 2

Economic Conditions

In 1930 the population was 533,500, or 17 percent of the total in the State. Sixty percent of the people lived on farms, 22 percent lived in small towns or rural communities, and only 18 percent lived in towns of more than 2,500 inhabitants. New Bern, Elizabeth City, Wilson, and Rocky Mount are the only cities with a population of more than 10,000. The Tidewater contained only 34 persons per square mile compared to 75 per square mile in the Western Coastal Plain. Population growth has been most rapid in the Western Coastal Plain where, since 1900, there has been an increase of 68 percent compared to an increase of only 22 percent in the Tidewater counties.[3]

The available data indicate that there were about 157,000 individuals employed in the unit in 1935.[4] About 80 percent of these were engaged in agriculture, 9 percent in manufacturing, 6 percent in retail sales, 2 percent in wholesaling, and 3 percent in miscellaneous businesses, including the service industries. Among the 14,000 employees reported engaged in manufacturing were about 8,000 in the textile industry and about

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[3] U. S. Dept. Com., Bur. of the Census, 1930.

[4] U. S. Dept. Com., Consumer Market Data Handbook, 1939.

5,000 in the wood-using industries. It is known, however, that many more people were employed in the wood-using industries, at least part-time, as many of the farmers supplement their income by woods-work, and many small sawmills fail to report the number of their employees. Additional opportunities for work are needed, 12,000 persons reporting as unemployed at the time of the Census of Total and Partial Unemployment in November, 1937.

Agriculture is easily the leading industry in the unit. In 1936 the 53,000 farms produced crops valued at 63 million dollars. Tobacco and cotton are the two important cash crops in the western counties, with corn the most valuable feed crop. Irish potatoes and peanuts are substantial cash crops in certain localities; both Pamlico and Beaufort Counties produced about one million dollars worth of potatoes, while Bertie and Halifax Counties each produced peanuts valued at 1¼ million dollars. These 5 crops made up 88 percent of the value of all crops harvested in 1936. In the Western Coastal Plain tenants operate 70 percent of the farms but in the Tidewater they operate only 44 percent.5/ Because of the higher ratio of ownership in the Tidewater counties, there is a better opportunity for developing improved agricultural and forest practices on farmland.

Also, a large part of the non-farm population obtains its income by financing and supplying the farm population and marketing the harvested crops. This agricultural economy is based upon 3.5 million acres of land in farms, or 52 percent of the unit area.5/

Manufacturing has not developed as intensively here as in other parts of North Carolina. Only 6 percent of the people engaged in manufacturing in the State in 1935 were employed in this unit and they received only 4 percent of the manufacturing payroll of the State.6/ Value added by manufacturing amounted to only 12 million dollars compared to the State total of 378 million.7/ Forest industrial plants are most numerous, and are distributed throughout every county. Small plants manufacturing food products are next in numerical importance, but the 24 textile factories employ the most people and add most to initial values.

The transportation system is well developed in the Western Coastal Plain. The main line of the Atlantic Coast Line Railroad crosses the western tier of counties and the main line of the Norfolk and Southern passes through Pitt, Wilson, and Nash Counties. Branch railroads of the Atlantic Coast Line, Seaboard Air Line, and the Carolina Southern adequately supplement the main lines. Highways are generally paved and well distributed.

In the Tidewater counties the transportation facilities are less satisfactory. The only through railroad is the Norfolk and Southern which operates between Norfolk, Virginia and Charlotte, North Carolina. A few branch lines are available but their distribution is poor. The system of highways connects the towns but it leaves large rural areas without convenient all-season access to paved roads. Although deficient in railroads

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5/U. S. Dept. Com., Census of Agr., 1935.

6/U. S. Dept. Com., Consumer Market Data Handbook, 1939.

7/U. S. Dept. Com., Industrial Market Data Handbook, 1939.

and highways the Tidewater has several navigable waterways, notably the Intracoastal Canal and the lower reaches of the Chowan, Pamlico, and Neuse Rivers. Numerous smaller streams are navigable for shallow-draft vessels and Morehead City is a port for ocean-going vessels.

The assessed value of all real and personal property in this unit in 1937 was 290 million dollars, or 12 percent of the State total.[8] Forest land and timber accounted for 10 percent of the value of all property in Beaufort, Currituck, Hertford, Pasquotank, Pitt, and Washington Counties in 1937.[9] Although the proportionate value of forest property varied widely between counties, it did not exceed 21 percent in any of the 6 counties mentioned, and it is believed that 10 percent represents a close approximation to the ratio of forest property to all property in the unit.

For taxation purposes forest land is generally classified by tax assessors into 4 groups: waste land, cutover land, woodland, and timberland. Little uniformity exists between counties in the definition of these land classes, and in many counties one or more of the classifications may be omitted. Assessments, tax rates, and taxes per acre may vary greatly between counties, or even between townships of the same county. Data gathered in 1937 in the 6 counties mentioned above indicate that waste land was assessed at $3.21 to $6.99 per acre, cutover land at $8.87 to $10.60, woodland at $7.94 to $9.84, and timberland at $6.93 to $18.21 per acre. The county-wide tax rate, exclusive of special school or road district levies, ranged from 90 cents to $1.80 per $100 of assessed valuation. Taxes per acre ranged from 4.1 cents on waste land in Beaufort County to 17.3 cents on timberland in Hertford County.

Public ownership of forest land is limited to 87,000 acres in the Croatan National Forest in Carteret and Craven Counties, 23,000 acres in the Mattamuskeet and Swanquarter wildlife refuges, about 2,000 acres owned by the State Board of Education, and less than 2,000 acres in the Fort Macon and Cape Hatteras State Parks. About 1,777,000 acres of the forest land in private ownership is distributed among the 53,000 farms. Commercial holdings actively operated for timber production amount to at least 468,000 acres. The remainder, about 1,686,000 acres, is owned largely by railroads, insurance companies, heirs of dissolved lumber companies, banks, and interests promoting drainage projects. They generally lease the timber cutting rights to local operators.[10]

Land-use involves a complex mingling of agricultural and forest land. A timber type map of 36 square miles in Pitt County illustrates the typical distribution of forest and crop land throughout much of the unit (fig. 2). Forest land is obviously preponderant. It occurs in small patches throughout the agricultural land as well as in extensive unbroken tracts. Open

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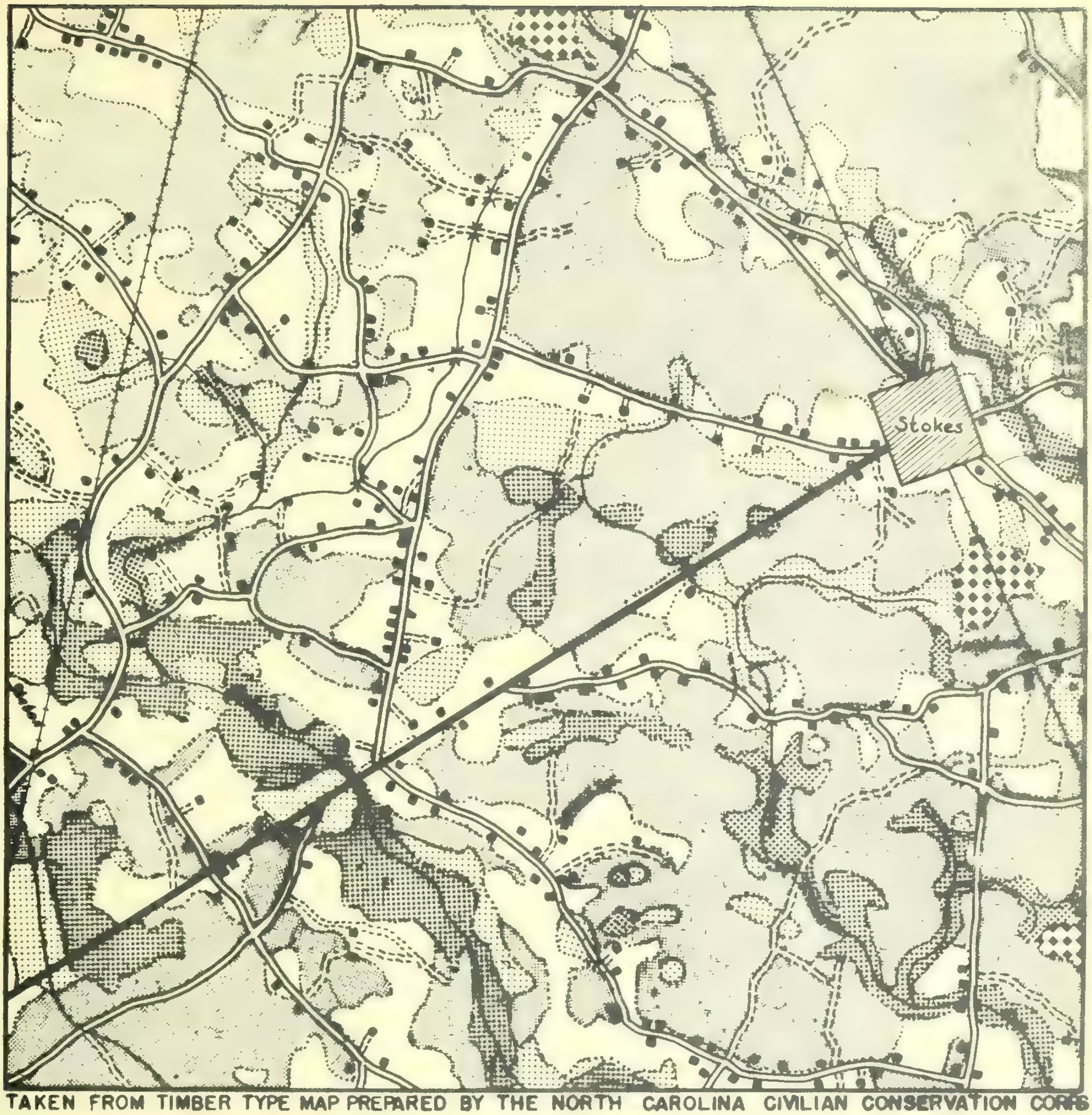
[8] N. C. Ind. Dir. and Ref. Book, Dept. of Cons. and Dev., Raleigh, N.C.

[9] Taxation of Forest Property in North Carolina, R. W. Nelson, Forest Taxation Inquiry, U. S. Forest Service.

[10] Div. State and Private Forestry, Reg. 8, U. S. Forest Service, Atlanta, Georgia.



TAKEN FROM TIMBER TYPE MAP PREPARED BY THE NORTH CAROLINA CIVILIAN CONSERVATION CORPS

LEGEND

▨	LOBLOLLY PINE	▬	PAVED ROADS
▨	LOBLOLLY PINE-HARDWOOD	═	GRADED ROADS
▨	POND PINE	┅	WOODS ROADS
▨	BOTTOM LAND HARDWOODS	┼┼┼	RAILROADS
☐	NONFOREST LAND	●●●	DWELLINGS

SCALE OF MILES

1 0 1 2

FIGURE 2- CHARACTERISTIC DISTRIBUTION OF FIELDS, FORESTS, DWELLINGS, AND TRANSPORTATION FACILITIES.

land parallels the roadways but nearly every field is bordered on at least one side by woodland. Stream margins are generally forested. Paved highways and improved secondary roads facilitate intensive land use as they provide convenient access to nearly every area, whether forested or agricultural. Dwellings are likely to be concentrated on the open land, where small farms provide the major share of the income, but forested land, with its capacity to produce raw material and provide work, is literally at the back door of every rural home. This close relation between agriculture and timber production means that nearly every farmer, both tenant and owner, has some influence upon the management of forest land.

A summary of the land-use situation at the end of 1937, as determined by the Forest Survey, is presented in table 1. Forest land comprises three-fifths of all the land in the unit and occupies nearly twice as much area as cropland and open pasture combined. In the Tidewater counties two-thirds of the land is forested, compared with about half in the Western Coastal Plain. The total area of forest land will fluctuate with the agricultural booms and depressions and also with the slow rotation typified by land clearing for new cropland, abandonment after several years of intensive cultivation, and the re-establishment of forest cover. Because of the low, swampy topography of a large part of this unit timber production is the most feasible land use.

Table 1. - Total area classified according to land use, 1937

Land use	Area	Proportion of total area
	Acres	Percent
Forest	4,045,500	60.8
Nonforest:		
Agriculture:		
Old cropland	2,073,900	31.1
New cropland	29,500	0.4
Pasture	52,400	0.8
Total agriculture	2,155,800	32.3
Abandoned cropland	37,600	0.6
Other nonforest	418,400	6.3
Total nonforest	2,611,800	39.2
Total area	6,657,300	100.0

DESCRIPTION OF THE FOREST RESOURCE

The forest occurs on 4,045,500 acres, or 61 percent of the unit area. It consists of trees of all sizes and ages, but is typically composed of medium-sized second-growth timber. Many species make up the forest stand, including four pines, white and red cedar, cypress, and a great variety of hardwoods.

Species

Loblolly pine is the most prevalent single species, making up about half of the sound-tree cubic-foot volume in the forest (table 2). It is found associated with all species and on all but the wettest sites. Black and tupelo gums are the next most abundant species-group. They are widely distributed, but Gates, Hertford, Bertie, Martin, Washington, and Tyrrell Counties contain most of the larger trees. Red gum is found all over the unit although less commonly in Dare and Hyde Counties. Pond pine is the characteristic species in these counties. It also occurs in relatively pure stands in parts of Tyrrell, Chowan, Beaufort, Pamlico, Craven, and Carteret Counties. The best stands of cypress are in Tyrrell County, along the lower reaches of the Roanoke River, and in the bottomlands at the confluence of the Meherrin and Chowan Rivers. In general, large white oaks are most common on the watershed of the Roanoke River and the headwaters of the Tar River. The greatest concentration of large red oaks and ash is in Martin and Bertie Counties in the bottomlands of the Roanoke River. Commercial stands of white cedar are found chiefly in Tyrrell County and the Dismal Swamp.

Forest Types

Certain groupings of species are so characteristic and wide-spread that they serve as a basis for classifying the forest into forest types. Eleven types were recognized in the field survey but in this report they have been combined into 4 broad types; loblolly pine-hardwoods, pond pine-hardwoods, upland hardwoods, and bottom-land hardwoods.

The loblolly pine-hardwoods type is the most extensive and most important commercially, occupying 47 percent of all the forest land and supplying fully three-fourths of the annual lumber cut. Almost half of the area in this type supports nearly pure stands of loblolly pine, the other half supports loblolly pine in mixture with hardwoods, with an occasional small area of longleaf or shortleaf pine. The loblolly pine-hardwood stands commonly occur along the streams in conjunction with the bottom-land hardwoods (fig. 2). Seventy-eight percent of the type volume is loblolly pine, 9 percent is red, black, and tupelo gum, and 5 percent is oak. The wide distribution of this type is indicated in figure 3, which shows the general location of the main forest types, but no distinction is made between forest and the included agricultural land.

The pond pine-hardwoods type, occupying 22 percent of the forest area, presents one of the major forest problems in the unit. It occurs as thinly-stocked stands in the swamps and pocosins throughout the Tidewater and is the dominant type over most of Dare, Hyde, and Tyrrell Counties. In these counties particularly, repeated fires have destroyed much of the timber and in many cases have burned the peat soils for a depth of several feet, with the result that large areas of open land support only a dense cover of brush and an occasional snag or half-dead pond pine. Locally these are called "lights" or "open ground" and some are of such long standing that the oldest resident cannot remember when they were timbered. It is questionable whether any expense should be incurred in developing a forest cover upon these lands as the site is generally too poor to produce good-quality commercial timber. Sawlog-size pond pine is not much in demand because of its poor quality, low volume per acre, and inaccessible location.

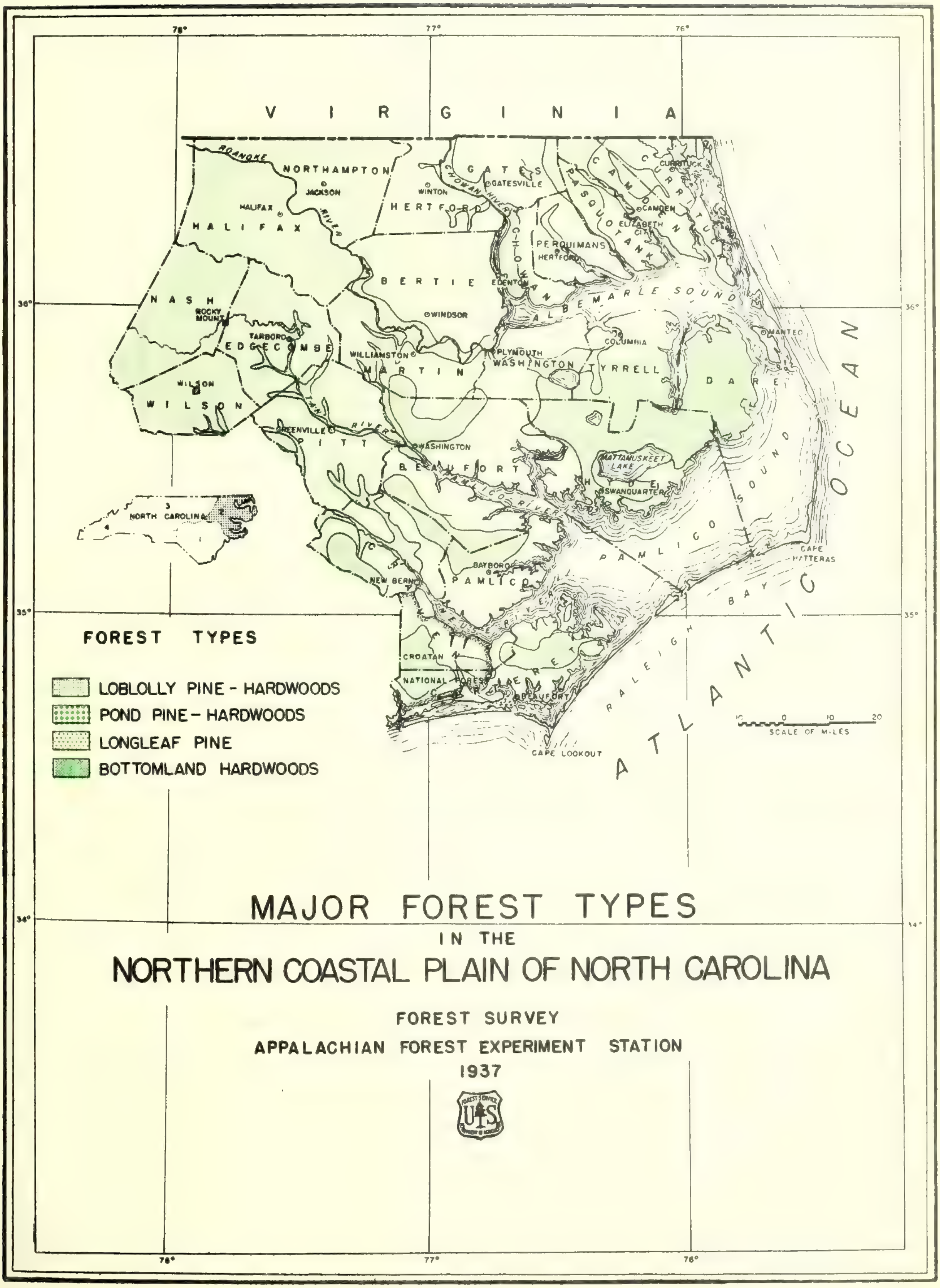
Table 2. - Species composition of the forest types, 1937*

Species	Loblolly pine-hardwoods	Pond pine-hardwoods	Upland hardwoods	Bottom-land hardwoods		All types
				Mixed hardwoods	Cypress-white cedar	
			Percent			
Loblolly pine	78.2	8.3	13.8	6.6	6.4	49.8
Pond pine	0.9	85.6	--	0.2	1.0	6.0
Longleaf pine	1.2	0.8	0.4	--	--	0.8
Shortleaf pine	2.0	0.2	1.4	0.1	0.5	1.3
White cedar	0.2	0.8	--	0.6	29.0	2.4
Cypress	0.3	0.4	0.2	4.7	27.2	3.3
Red gum	5.5	0.3	16.8	18.8	2.0	8.4
Black gums**	3.2	1.9	5.2	38.3	23.3	13.1
Yellow poplar	0.8	Negl.	4.4	2.5	0.3	1.2
Red oaks	2.1	0.1	12.4	3.5	0.2	2.5
White oaks	2.8	0.1	21.4	3.4	0.9	3.1
Ash	0.1	--	0.4	3.6	1.6	1.0
Holly, dogwood, persimmon	0.4	--	2.6	1.0	0.2	0.5
Scrub hardwoods	0.4	0.7	3.1	1.3	1.0	0.8
Other hardwoods	1.9	0.8	17.9	15.4	6.4	5.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

*Based on cubic-foot volume (o.b.) of trees 5.0 inches d.b.h. and larger.

**Includes black and tupelo gums throughout the report.

The upland hardwood type exists in such small scattered tracts that it is not feasible in figure 2 to delineate its area. Only 157,200 acres, or 4 percent of the forest land, support this forest type. Most of it is located in Beaufort, Bertie, Halifax, Nash, and Northampton Counties. The upland hardwood stands are usually contiguous with the loblolly pine-hardwood stands, differing only in having a smaller proportion of pine. White and red oaks with red gum make up half the volume, loblolly pine comprises 14 percent, and miscellaneous hardwoods the remainder.



MAJOR FOREST TYPES
IN THE
NORTHERN COASTAL PLAIN OF NORTH CAROLINA

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1937

Figure 3

The broad type designated as bottom-land hardwoods occupies 27 percent of the forest land and includes 920,300 acres of mixed hardwoods, 82,700 acres of cypress and tupelo gum, and 81,900 acres of white cedar mixed with hardwoods. In table 2 the mixed hardwoods contain nearly 60 percent red, black, and tupelo gum, while the combined cypress and white cedar types contain 56 percent cypress and white cedar and only 25 percent gum. The bottom-land hardwoods type occurs along the rivers and smaller streams (fig. 2) and in the swamps, with the white cedar component most abundant in the swamps of Dare, Tyrrell, and Gates Counties.

An unusually high proportion (53 percent) of the forest land is in swamps, ponds, and river bottoms, topographic situations that are dominated by the pond pine-hardwoods and bottom-land hardwoods types. Of the remaining forest land, the loblolly pine-hardwoods type occupies 82 percent.

Table 3. - Forest area classified according to forest type and topographic situation, 1937

Forest type	Rolling uplands	Level lowlands	Bays, ponds and swamps	River bottom-lands	Total	Proportion of total
	- - - - - - - - - -	- - - - - - - - - -	Acres	- - - - - - - - - -	- - - - - - - - - -	Percent
Loblolly pine-hardwoods	424,200	1,124,900	189,900	173,600	1,912,600	47.3
Pond pine-hardwoods	--	101,500	789,300	--	890,800	22.0
Bottom-land hardwoods	--	86,000	246,500	752,400	1,084,900	26.8
Upland hardwoods	89,200	68,000	--	--	157,200	3.9
Total	513,400	1,380,400	1,225,700	926,000	4,045,500	100.0
Percent of total	12.7	34.1	30.3	22.9	100.0	

Forest Conditions

The forest resource is composed of stands having different ages, volumes-per-acre, and cutting histories, factors that serve as a basis for classifying the stand into forest conditions (table 4). Such a classification discloses 63 percent of the forest land supporting sawlog-size stands, 34 percent supporting under-sawlog-size stands, with less than 4 percent clear-cut.

Sawlog-size stands occupy about 10 percent more of the forest area in this unit than in the Southern Coastal Plain unit of North Carolina. About 57 percent of the 2.5 million acres of saw timber is loblolly pine-hardwoods, 29 percent is bottom-land hardwoods, 10 percent is pond pine-hardwoods, and only 4 percent is upland hardwoods. One-fifth of the saw-timber area is stocked with old growth, nearly two-thirds of which is bottom-land hardwoods. The 2 million acres of second-growth saw timber is predominantly loblolly pine-hardwoods although the bottom-land hardwoods are found on 20 percent of this second-growth area. The second-growth pine stands are the chief source of material for the pine sawmills while most of the hardwood mills are still cutting old-growth timber.

Under-sawlog-size stands (excluding clear-cut) occupy 1.4 million acres, or one-third of the unit area. These young stands will rapidly supplement the saw-timber stands, especially if they are protected from fire and are thinned where necessary. Least productive will be the one-half million acres in the pond pine type, making up two-fifths of all the under-sawlog-size area. These pond pine stands are subject to more frequent burning than the other types and generally grow on less productive sites.

Almost all of the area classified as clear-cut is the "open-land" in Dare, Hyde, and Tyrrell Counties. In most cases fire destroyed the timber, and clear-cutting by lumbermen is not an important cause of this devastation. Some of the land will restock to pond pine through natural seeding and sprouting, but most of it has been so heavily burned that planting is probably the only way to re-establish a forest cover. The site is so poor, however, that large scale planting is not recommended unless suitable research demonstrates that planting is practical and desirable.

Table 4. - Forest area classified according to forest condition and forest type, 1937

Forest condition	Loblolly pine-hardwoods	Pond pine-hardwoods	Upland hardwoods	Bottom-land hardwoods	Total all types	Proportion of total
	- - - - - - - - - - -	- - - - -	Acres	- - - - -	- - - - - - - - - - -	Percent
Sawlog size:						
Old growth:						
Uncut	45,000	22,900	1,700	124,500	194,100	4.8
Partly cut	95,800	9,000	23,700	217,000	345,500	8.6
Total	140,800	31,900	25,400	341,500	539,600	13.4
Second growth:						
Uncut	620,600	190,000	15,600	267,700	1,093,900	27.0
Partly cut	687,000	36,800	49,100	128,500	901,400	22.3
Total	1,307,600	226,800	64,700	396,200	1,995,300	49.3
Total sawlog size	1,448,400	258,700	90,100	737,700	2,534,900	62.7
Under sawlog size:						
Second growth	397,900	321,800	60,500	263,700	1,043,900	25.8
Reproduction	57,300	181,700	6,600	74,500	320,100	7.9
Clear-cut	9,000	128,600	--	9,000	146,600	3.6
Total under sawlog size	464,200	632,100	67,100	347,200	1,510,600	37.3
Total all conditions	1,912,600	890,800	157,200	1,084,900	4,045,500	100.0
Percent of total	47.3	22.0	3.9	26.8	100.0	

Site Quality

The productive capacity of forest land depends upon the quality of the site, which is determined by the interplay of many factors, chiefly those having to do with climate and soil conditions. A commonly used index of site quality is the height of average dominant forest trees at 50 years of age. In the loblolly pine-hardwood type area of nearly 2 million acres the land was classified according to site quality, using loblolly pine as the criterion. The results (table 5) show that the factors of site are very favorable for the growth of loblolly pine, as over 80 percent of the loblolly area had a 70-foot or better site index. Most of the 90-foot or better sites are located northeast of the Roanoke River. Differences in topography influenced site to some extent, most noticeably in the river bottom lands where the soil is more fertile and moisture more abundant.

Table 5. - Loblolly pine area classified according to site

Topographic division	Site index in feet		
	90 or more	70 and 80	60 or less
	Percent		
Rolling uplands	2	82	16
Level lowlands	6	75	19
Bays, ponds, and swamps	3	81	16
River bottom lands	21	74	5
Average	6	77	17

The vigorous appearance of the standing loblolly timber in this unit is visual evidence of the excellent growing conditions. Loblolly pine sites are better here than in the southern part of the North Carolina Coastal Plain. Even better sites occur, however, in the coastal plain of South Carolina where over 90 percent of the loblolly pine area has a 70-foot or better site index.

Age

Generally speaking, the forest of this unit is composed of many even-aged groups of trees. Clumps of reproduction, saplings, and saw-timber trees often occur together, resulting in a forest stand containing several age-class groups. On other areas, such as old-fields or forest tracts where clear-cutting was practiced, the stand may consist of one dominant age-class. Where practical the age of each survey plot was recorded and the resulting data provides an estimate of the age of the forest at various stages of development.

Most of the trees in the reproduction stage are less than 10 years old. At 10 to 15 years the trees are large enough for the stand to be classified as second-growth under-sawlog-size. When about 25 years old many of the stands reach sawlog size. A majority of the second-growth pine saw timber is 25 to 55 years of age while the hardwood is 55 to 75 years. Very few stands of old-growth quality are less than 80 years old; most are 100 to 200 years. Stands less than 15 years old occupy 22 percent of the forest area, stands 15 to 25 occupy 11 percent, stands 26 to 75 occupy 51 percent, and stands more than 75 years old occupy 16 percent.

Stocking

The current amount or volume of sound timber on a given forest area is referred to as growing stock. The right quantity of growing stock for maximum volume increase varies with site and age of stand, but in all cases it is contingent upon complete use of the growing space. The term stocking refers to the quantity of growing stock; a fully stocked stand has a sufficient amount of growing stock for maximum growth while understocking connotes a deficiency.

In the diversified stands occurring in this unit the determination of the degree of stocking is a difficult matter. It is certain, however, that the stocking is highly irregular throughout the forest; a result of fires, uncontrolled cutting, and uneven natural restocking. Although total volume is of limited value as a measure of stocking it indicates in a general way the understocked condition of the forest stand under discussion. In the pine types a comparison is made of the average cordwood volume per acre on uncut areas in representative age-classes with the average volumes, weighted by site, of the best-stocked 10 percent of these same stands (table 6). These best-stocked stands approximate full stocking, indicating that the average volume per acre is now only 40 to 60 percent of the volume of fully stocked stands. There is evidently an excellent opportunity to increase the volume and quality of the growing stock with good fire control and with even the more simple forms of forest management.

Table 6. - Average volumes per acre, by age-classes, in the uncut conditions of the pine-hardwood types.

Age-class	Based on all stands	Based on best 10 percent of stands	Relation of all stands to best 10 percent
Years	Cords	Cords	Percent
21 - 30	8.8	23.0	38
31 - 40	17.5	42.0	42
41 - 50	24.5	47.4	52
51 - 60	28.4	49.5	57
Weighted average of all age-classes	19.3	37.7	51

The stocking of the second-growth sawlog-size condition (pine and hardwood types combined) is of particular significance because this condition occupies one-half of the forest area and is the source of most of the saw timber. A diameter-class comparison of the average number of pine and hardwood trees per acre is presented in figure 4. The number and distribution of hardwoods in the smallest diameter classes seems adequate to maintain or even increase the hardwood saw-timber growing stock. The diameter-class distribution of the 4-, 6- and 8-inch pines will increase the board-foot growing stock at the expense of the cubic-foot stand because with growth more trees will move out of the 6- and 8-inch diameter classes into sawlog size than will move from the 4-inch class into cubic-foot size (5.0 inches d.b.h.).

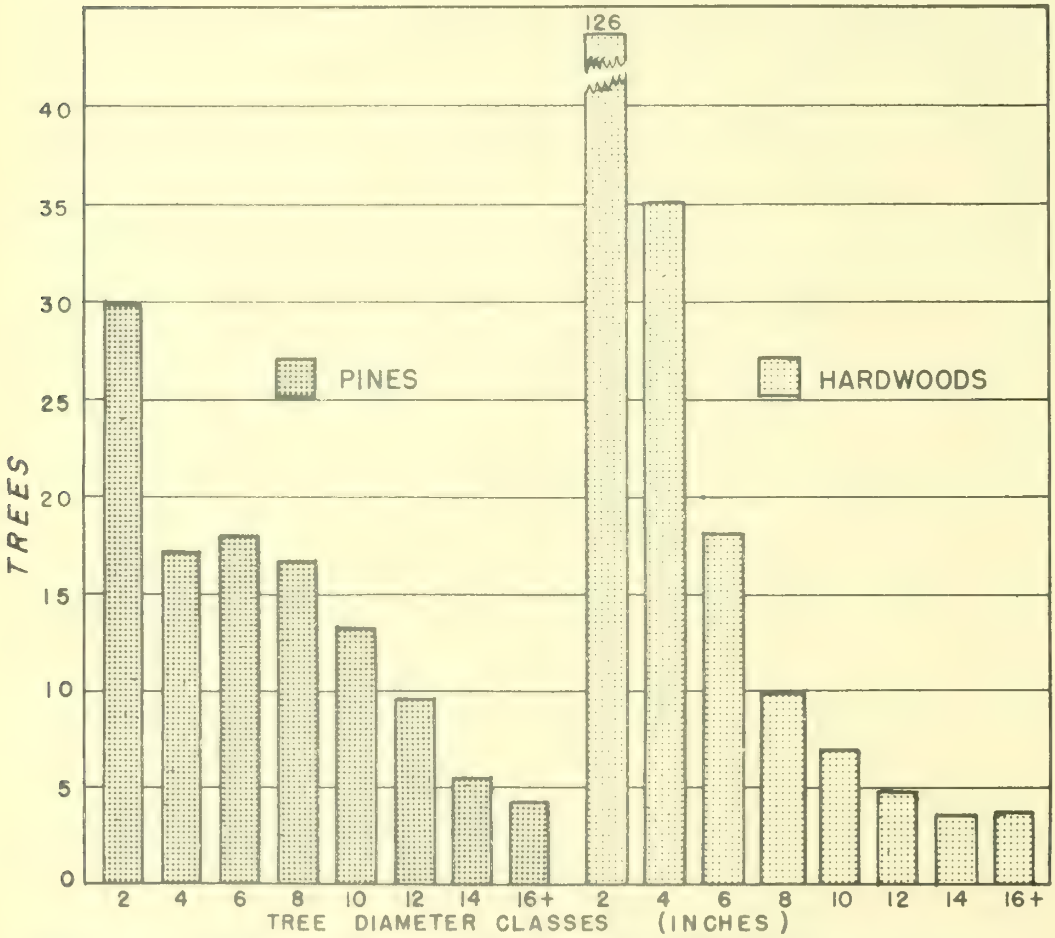


FIGURE 4.- AVERAGE NUMBER OF PINE AND HARDWOOD TREES PER ACRE IN THE SECOND-GROWTH SAWLOG-SIZE CONDITION.

Fire

Uncontrolled forest fires have an important and detrimental effect upon site quality and density of stocking, vital factors in the yield from the forest stand. Site quality is lowered when soil conditions are impaired by the destruction of the forest litter and the organic matter above the mineral soil. Stocking is reduced by surface fires that destroy seeds in the forest litter, kill reproduction and young saplings, and create fire-scars on larger trees allowing entrance of rot-producing fungi.

Surface fires are the most common kind in this unit, but the ground fires that occur in the muck lands supporting pond pine and cedar are more serious, as they frequently burn off not only all vegetation but the soil itself to a depth of several feet. At the time of the survey 71 percent of the forest land gave evidence of having been burned over; a proportion that represents the accumulated burned acreage of many fire seasons. Prevalence of fire and intensity of damage varied considerably within forest types. Evidence of fire was present on only half of the bottomland hardwood type area in contrast to the pond pine-hardwood type with 97 percent of its area burned, one-third with heavy damage. Fire had occurred on three-fourths of the loblolly pine-hardwood type area but heavy damage, evidenced by dead trees and numerous fire-scars, was apparent on only one percent.

THE VOLUME OF THE FOREST RESOURCE

The inventory of the timber resource in 1937 included the sound volume in all living trees 5.0 inches d.b.h. or larger. Volumes expressed in board feet include only the sawlog portion of saw-timber trees (pines, cypress, and white cedar 9.0 inches d.b.h. and larger, hardwoods 13.0 inches d.b.h. and larger). Cordwood volumes (wood and bark) include the sawlog portion of all saw-timber trees, the upper portion of saw-timber trees not used as sawlogs but acceptable as cordwood, the sound stems of under-sawlog-size trees, and the sound volume in cull trees. Bark is omitted from cubic-foot volumes, otherwise the material is similar to that contained in cordwood.

Board-foot Volume[1]

At the time of inventory the volume of the forest resource was 14.3 billion board feet, expressed in the International ¼-inch log rule which is used throughout the report after table 7. This volume is the approximate amount of green lumber that could be sawed from the standing saw-timber trees and is one-third of the total board-foot volume in the forests of the State.

Table 7. - Net volume by the International, Scribner and Doyle rules classified according to species-group, 1937

Species-group	International*	Scribner	Doyle
	Thousand board feet		
Pines:			
Loblolly	8,106,300	6,970,000	4,761,700
Pond	756,600	629,700	390,800
Longleaf	119,400	101,500	68,700
Shortleaf**	158,700	133,200	85,500
Total pines	9,141,000	7,834,400	5,306,700
Hardwoods:			
Black gums	1,504,200	1,385,100	1,106,800
Red gum	1,259,600	1,152,800	915,400
Yellow poplar	190,600	174,400	138,700
Red oaks	285,600	264,400	224,600
White oaks	321,500	300,700	257,200
Ash	109,600	99,400	75,600
Other hardwoods	569,800	508,600	402,500
Total hardwoods	4,240,900	3,885,400	3,120,800
Cypress	636,000	563,300	396,700
White cedar	318,000	267,900	172,500
Total all species	14,335,900	12,551,000	8,996,700

*The scale by this rule approximates green lumber tally.
**Includes red cedar.

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[1] See glossary for description of material included in board-foot volume.

The Scribner rule is widely used in various parts of the country but only occasionally in the South. Until recently it was the official rule of the United States Forest Service, a distinction now shared with the International rule. The amount of lumber obtainable is underestimated by this rule because it is based upon a diagram of the small end of the log and does not allow for taper. Furthermore it was formulated over 90 years ago and fails to allow for the improved sawmill machinery and closer utilization of the present time. As a result the board-foot volume in the unit estimated by the Scribner rule is only 12.6 billion board feet.

Custom has long dictated the use of the Doyle rule in the South. It is a highly inaccurate rule and underscales small trees excessively. The percent of error varies with every stand of timber because of differences in diameter distribution, one reason why varying the stumpage price does not allow correctly for the inaccurate scale. In this unit where small trees predominate, the volume by the Doyle rule is only 63 percent of the volume by the International rule. In other words, the timber will saw out nearly 60 percent more lumber than the Doyle rule indicates.

The total volume of pine saw-timber, chiefly loblolly, exceeds 9 billion board feet (table 8). Only 18 percent of this volume is located in old-growth stands. Half of the pine volume is in sawlog-size stands of uncut second growth. These stands occupy about one million acres, average nearly 6,000 board feet per acre, and are in reality the main support of the pine lumber industry. Second-growth stands which have had part of their volume removed contain 29 percent of the volume. The residual volume averages about 4,000 board feet per acre, sufficient to justify commercial logging. The partial cutting improves growth conditions for the remaining trees and where possible these partly-cut stands should be left to make rapid growth for several years. About 3 percent of the board-foot volume is in young stands containing only an occasional saw-timber tree. Because these trees are scattered most of this volume will remain unutilized until the young stand as a whole grows to sawlog size.

About 55 percent of the hardwood volume is in old-growth stands, located chiefly in the less accessible swamps and bottom lands of the larger rivers. Part of this old-growth volume is composed of second-growth trees that occur in conjunction with the old growth. Nearly two-fifths of the total old-growth volume is red, black, and tupelo gum, species not extensively used for lumber when the region was first logged over. Second-growth stands, containing 43 percent of the hardwood board-foot volume, are three-fifths gum and nearly one-fifth oak. Less than 2 percent of the hardwood volume is in under-sawlog-size stands.

Table 8. - Net volume by the International $\frac{1}{4}$-inch rule classified according to species-group and forest condition, 1937

Species-group	Sawlog size				Under sawlog size*	Total	Proportion of total
	Old growth		Second growth				
	Uncut	Partly cut	Uncut	Partly cut			
	Thousand board feet						Percent
Pines:							
Loblolly**	699,400	837,400	4,103,600	2,564,700	179,300	8,384,400	58.5
Pond	79,600	37,500	496,900	74,700	67,900	756,600	5.3
Total pines	779,000	874,900	4,600,500	2,639,400	247,200	9,141,000	63.8
Hardwoods:							
Black gums	576,000	505,600	267,900	132,400	22,300	1,504,200	10.5
Red gum	215,700	355,600	371,400	295,700	21,200	1,259,600	8.8
Yellow poplar	41,300	25,100	79,300	40,400	4,500	190,600	1.3
Red oaks	34,200	70,000	97,800	80,100	3,500	285,600	2.0
White oaks	49,300	120,300	61,400	83,700	6,800	321,500	2.2
Other hdwds.	117,900	236,100	211,100	91,000	23,300	679,400	4.8
Total hardwoods	1,034,400	1,312,700	1,088,900	723,300	81,600	4,240,900	29.6
Cypress	180,100	203,700	191,500	53,000	7,700	636,000	4.4
White cedar	68,100	70,300	174,100	1,300	4,200	318,000	2.2
Total all species	2,061,600	2,461,600	6,055,000	3,417,000	340,700	14,335,900	100.0
Percent of total	14.4	17.2	42.2	23.8	2.4	100.0	

*Includes the reproduction and clear-cut conditions.
**Includes longleaf and shortleaf pines, and red cedar.

Although there is a considerable volume of oak, cypress, white cedar, and ash, the predominant supply of board-foot material is second-growth loblolly pine and the red, black and tupelo gums. In fact, loblolly pine and the gums account for 78 percent of all the board-foot volume in the unit.

Sixty-two percent of the pine volume is in trees 13.0 inches d.b.h. and larger (fig. 5). Many of the pine sawmill operators in the unit prefer logs from trees in the 14- to 18-inch diameter classes; such trees contain 46 percent of the pine volume. Logs from trees larger than 20 inches d.b.h. are difficult and expensive to handle in most of the small pine mills so common throughout the unit.

Trees less than 19.0 inches d.b.h. contain 58 percent of the hardwood and 75 percent of the cypress volume. Operators of large hardwood band mills generally prefer logs from trees over 20.0 inches d.b.h. but some operators of hardwood mills cutting about 20,000 board feet per day consider an 18-inch second-growth log of good quality the most desirable material.

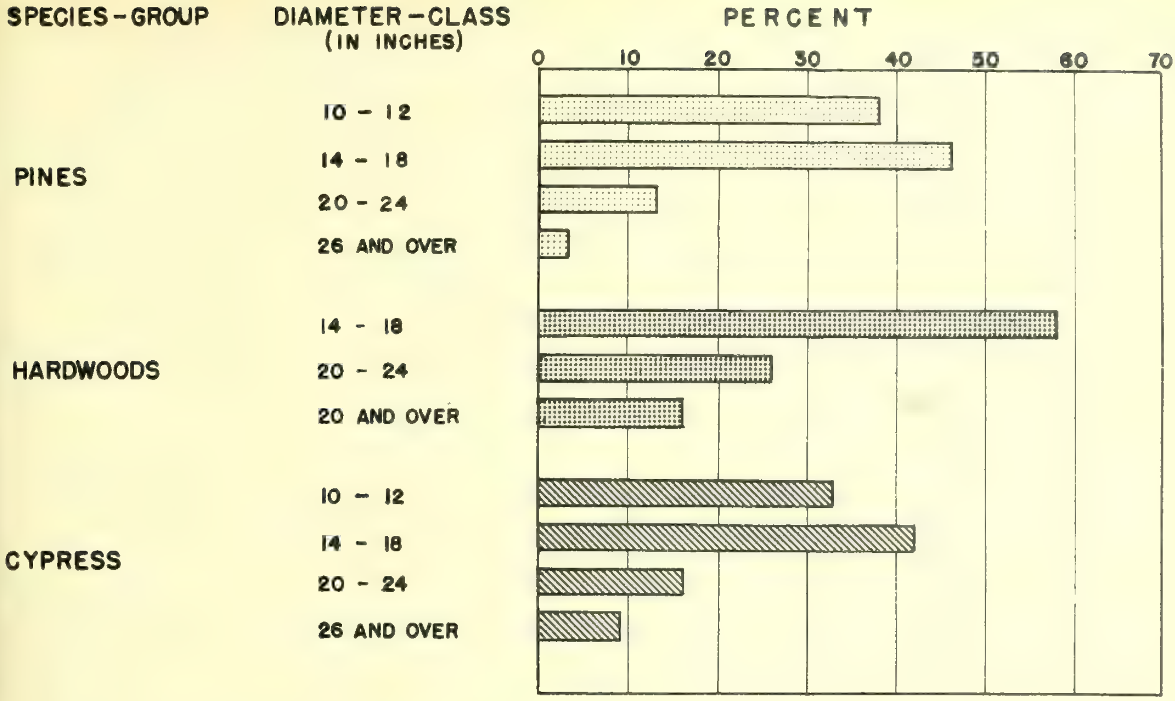

FIGURE 5: DIAMETER DISTRIBUTION OF BOARD-FOOT VOLUME (INTERNATIONAL 1/4-IN. RULE)

The effect of tree diameter upon lumber values has been investigated by the U. S. Forest Products Laboratory. A study of selective logging in a loblolly pine-hardwood stand of this unit led to the following statement, still generally applicable to pine even though lumber prices may have changed since the investigation. "Generally, the larger and older the tree the greater the proportion of high-grade lumber. Small trees not only yield poorer quality lumber than large trees but, grade for grade, it is worth less because the average width is less. For example, in loblolly pine the B and better lumber from 9-inch trees is worth only $41.42 per thousand board feet, whereas that from 20-inch trees is worth $47.02."[2]

Although a high proportion of the board-foot volume is in small or medium-sized trees, most of the volume is concentrated on areas with a stand per acre heavy enough to provide for practical logging operations. This is illustrated in figure 6, where the proportion of the forest area supporting different volumes per acre is shown along with the proportion of the volume in these volume-per-acre classes. The volume under consideration is 98 percent of the total in the unit.

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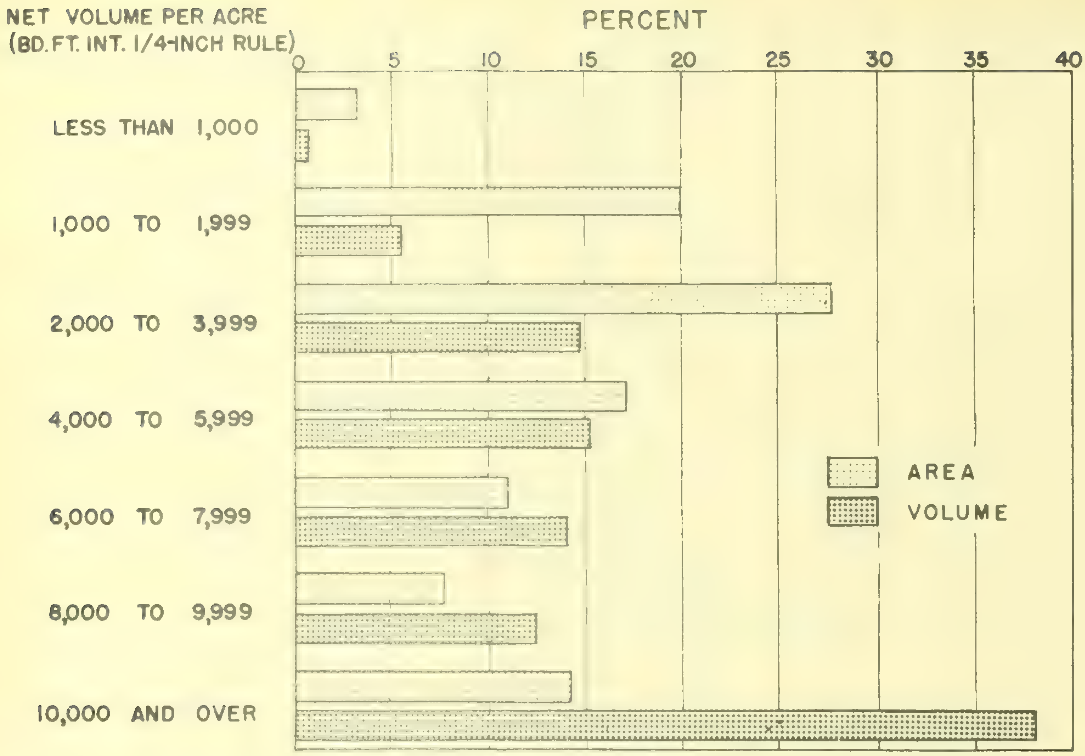
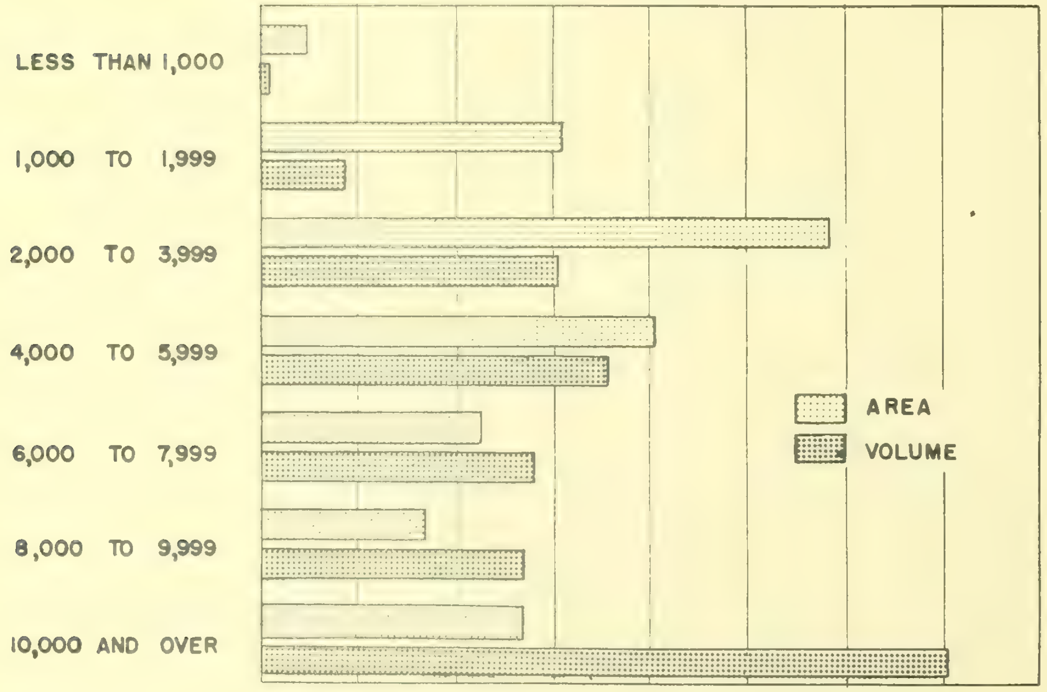
[2] Garver, R. D. and J. B. Cuno. The portable band sawmill and selective logging in the loblolly pine forests of North Carolina. U. S. Dept. Agr. Tech. Bul. 337, p. 16. 1932.



A.- PINE - HARDWOOD TYPES



B.- HARDWOOD TYPES

FIGURE 6.- DISTRIBUTION OF AREA AND BOARD-FOOT VOLUME IN THE SAWLOG-SIZE CONDITIONS, CLASSIFIED ACCORDING TO VOLUME OF SAW TIMBER PER ACRE

The sawlog-size conditions of the pine-hardwood types (loblolly pine-hardwoods and pond pine-hardwoods) occupy 1.7 million acres and contain 9.4 billion board feet. Seventy-seven percent of this area is stocked with more than 2,000 board feet per acre, containing in the aggregate 94 percent of the board-foot volume. Nearly 40 percent of the volume is in stands of at least 10,000 board feet per acre.

The sawlog-size conditions of the hardwood types (upland and bottomland hardwoods, including cypress and white cedar) occupy 828,000 acres and contain 4.6 billion board feet. Eighty-two percent of this area is stocked with more than 2,000 feet per acre, and 96 percent of the volume is contained thereon. About 35 percent of the hardwood volume is in stands of 10,000 board feet or more per acre.

Most of the loblolly pine volume is readily accessible. Waterways provide access to much of the land bordering the sounds and broad rivermouths, while farther inland the distribution of roads in relation to forest land resembles that shown in figure 2. Timber situated in the swamps and river bottoms is accessible if the volume per acre and the total loggable volume is enough to justify construction of a railroad or canal. Much of the pond pine is hard to log, and its poor quality and low volume per acre have retarded its exploitation. Before extensive use is made of the black gum inexpensive methods must be developed for logging the small trees in the gum "necks" and swamps.

The average stand per acre varies noticeably by forest condition and type (table 9). The heaviest average stand is found in the old-growth uncut condition of the loblolly pine-hardwood type but because of its restricted occurrence it has comparatively little significance as a source of saw timber. Of far greater importance is the average stand of 6,900 board feet per acre in the second-growth uncut condition of this same type. Occupying 15 percent of the forest land, the aggregate volume of these stands is 30 percent of all the volume in the unit. The average volume of all conditions in this type is 4,600 board feet per acre, compared with 2,930 board feet in the Southern Coastal Plain of North Carolina.

The pond pine-hardwoods type occupies nearly one-fourth of the forest area, but its average volume per acre is less than 1,000 board feet. Although this low volume reflects the influence of the large areas of reproduction and clear-cut land, the saw-timber conditions also contain only a small volume of timber per acre.

Table 9. - Average board-foot volume per acre by the International $\frac{1}{4}$-inch rule classified according to forest type and forest condition, 1937

Forest type	Sawlog size					Under sawlog size*	Weighted average of all conditions
	Old growth		Second growth		Weighted average		
	Uncut	Partly cut	Uncut	Partly cut			
	Board feet						
Loblolly pine-hardwoods	15,300	8,770	6,940	4,090	5,970	340	4,600
Pond pine-hardwoods	3,330	4,090	2,800	1,920	2,770	100	870
Upland hardwoods	8,470	4,530	2,680	2,400	3,120	230	1,890
Bottomland hardwoods	10,300	6,810	4,400	3,260	5,900	310	4,110
Average all types	10,620	7,120	5,540	3,790	5,520	230	3,540

*Includes reproduction and clear-cut conditions.

Cordwood Volume[3]

The net volume of 73 million cords (table 10) includes the entire stand of sound trees 5.0 inches d.b.h. and larger, as well as the sound volume in cull trees. It is difficult to grasp the quantitative significance of 73 million cords, but it is nearly 10 times the amount of wood consumed by the pulp and paper industry in the United States in 1935.

The total stand of pine is 32.8 million cords. Seventy-eight percent of this volume is in sawlog-size trees, 18 percent is in under-sawlog-size trees, and 4 percent is in cull trees. Under the existing forest industrial organization, most of the 21 million cords of saw timber will contribute to the sawmill industry. Silviculturally, it would be good practice for the local pulp mills to utilize the sound volume in cull trees, the volume thinned from young stands, and the cordwood volume in the upper stems of felled saw-timber trees. In practice, however, the upper-stem wood must be "sweetened" by a rather high proportion of small saw timber.

As usual in the Coastal Plain of the South the cordwood volume of hardwoods exceeds that of pine. The total hardwood stand contains 36.6 million cords of which only 46 percent is in sawlog-size trees, 30 percent is in under-sawlog-size trees, and 24 percent is in cull trees. Wood pulp industries should consider the large quantity of raw material in the cull gum trees, as it is reasonably accessible and is not in demand by other industries. The heaviest commercial stands of southern white cedar occurred originally in this region and the 1.3 million cords in this unit form a large part of the white cedar along the eastern seaboard.

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[3] See glossary for description of material included in cordwood volume.

Table 10. - Net volume of all sound material, expressed in cords of wood with bark, 1937

Species-group	Sawlog-size trees		Sound trees under sawlog size	Cull trees	Total all classes	Proportion of total
	Sawlog material	Upper stems				
	- - - - - - - - - - - - -	- -	Cords - - - - - - - - - - - -			Percent
Pines:						
Loblolly*	19,306,700	3,865,500	5,136,500	537,500	28,846,200	39.4
Pond	1,811,200	531,800	919,300	662,200	3,924,500	5.4
Total pines	21,117,900	4,397,300	6,055,800	1,199,700	32,770,700	44.8
Hardwoods:						
Black gums	4,107,000	2,082,700	3,953,700	3,180,000	13,323,400	18.3
Red gum	2,987,800	1,728,000	2,176,400	1,034,100	7,926,300	10.8
Yellow poplar	450,600	261,600	274,500	122,000	1,108,700	1.5
Red oaks	751,000	395,300	751,100	480,100	2,377,500	3.3
White oaks	827,000	450,500	1,073,900	351,100	2,702,500	3.7
Other hdwds.	1,746,100	907,400	2,804,700	3,638,400	9,096,600	12.4
Total hdwds.	10,869,500	5,825,500	11,034,300	8,805,700	36,535,000	50.0
Cypress	1,537,200	425,200	286,600	208,000	2,457,000	3.4
White cedar	803,700	114,100	394,400	26,100	1,338,300	1.8
Total all species	34,328,300	10,762,100	17,771,100	10,239,500	73,101,000	100.0
Percent of total	47.0	14.7	24.3	14.0	100.0	

*Includes longleaf and shortleaf pines, and red cedar.

The cordwood volume shown in table 11 includes the entire stand of sound trees 5.0 inches d.b.h. and larger, but does not include cull trees or upper stems and limbs of sawlog-size hardwood and cypress trees. It is therefore 16.5 million cords less than the total volume in table 10. Among the species, red oaks have the highest proportionate volume in large trees and pond pine the lowest. Nearly 10 percent of all the volume shown is loblolly pine in the 6- and 8-inch diameter class.

Table 11. - Net cordwood volume of sound trees classified according to species-group and diameter-class, 1937

Species-group	Tree diameter-class (inches)				Total	Proportion of total
	6 - 8	10 - 12	14 - 18	20 and over		
	- - - - - - - - Cords (bark included) - - - - - - - -					Percent
Pines:						
Loblolly*	5,136,500	9,968,900	10,102,800	3,100,500	28,308,700	50.0
Pond	919,300	1,306,100	958,600	78,300	3,262,300	5.8
Total pines	6,055,800	11,275,000	11,061,400	3,178,800	31,571,000	55.8
Hardwoods:						
Black gums	1,508,200	2,445,500	2,581,600	1,525,400	8,060,700	14.3
Red gum	921,900	1,254,500	1,917,100	1,070,700	5,164,200	9.1
Yellow poplar	125,800	148,700	280,200	170,400	725,100	1.3
Red oaks	394,400	356,700	343,900	407,100	1,502,100	2.6
White oaks	518,100	555,800	400,000	427,000	1,900,900	3.4
Other hdwds.	1,375,500	1,399,200	1,216,800	559,300	4,550,800	8.0
Total hdwds.	4,843,900	6,160,400	6,739,600	4,159,900	21,903,800	38.7
Cypress	286,600	395,000	692,900	449,300	1,823,800	3.2
White cedar	394,400	492,100	372,300	53,400	1,312,200	2.3
Total all species	11,580,700	18,322,500	18,866,200	7,841,400	56,610,800	100.0
Percent of total	20.5	32.4	33.3	13.8	100.0	

*Includes longleaf and shortleaf pines, and red cedar.

A forest stand averaging 14 cords per acre (table 12) over 4 million acres is much better stocked than the average forest in the southern pine region. This average, moreover, includes clearcut, reproduction, and sapling areas having little volume. In the sawlog-size stands, occupying 63 percent of the forest area and containing the commercial volumes, the average stand is 21 cords per acre. The yield of 26 cords at an average age of 40 years in the second-growth uncut condition of the loblolly pine-hardwoods type indicates a yearly increase of nearly six-tenths of a cord under unmanaged conditions. By contrast, the same condition of the pond pine-hardwoods type increased by only two-tenths of a cord per year.

Table 12. - Average cordwood volume per acre, classified according to forest type and forest condition, 1937

Forest type	Sawlog size					Under sawlog size*	Weighted average of all conditions
	Old growth		Second growth		Weighted average		
	Uncut	Partly cut	Uncut	Partly cut			
	Cords						
Loblolly pine-hardwoods	41.2	25.3	25.8	16.4	21.8	3.7	17.4
Pond pine-hardwoods	10.3	14.0	11.3	7.8	10.8	0.9	3.8
Upland hardwoods	24.2	17.6	13.1	11.7	13.7	2.9	9.1
Bottomland hardwoods	33.0	23.9	21.6	16.1	23.2	4.0	17.1
Average all types	32.2	23.6	22.1	15.7	20.8	2.6	14.0

*Includes reproduction and clearcut areas.

Cubic-foot Volumes

Cubic volume affords the most uniform and accurate standard of measurement for both saw-timber and cordwood material. It is particularly useful in comparisons between stand volume, forest growth and wood use. In table 13 the net volume of all sound wood in the stand has therefore been summarized in cubic feet. Bark is not included.

Table 13. - Net volume of all sound material expressed in cubic feet, 1937

Species-group	Sawlog-size trees		Sound trees under sawlog size	Cull trees	Total all classes	Proportion of total
	Sawlog material	Upper stems				
	Thousand cubic feet					Percent
Pines	1,520,420	312,990	397,240	84,010	2,314,660	46.8
Hardwoods	736,330	346,110	701,290	564,990	2,348,720	47.5
Cypress	119,250	25,740	20,410	15,290	180,690	3.6
White cedar	62,240	8,770	29,290	1,990	102,290	2.1
Total all species	2,438,240	693,610	1,148,230	666,280	4,946,360	100.0
Percent of total	49.3	14.0	23.2	13.5	100.0	

Poles

During the course of the field inventory the loblolly, longleaf, and shortleaf pine trees ranging from 7.0 to 18.9 inches d.b.h. were classified as to their suitability for poles. About 12 percent of them qualified for this special use (table 14). Twelve million pole trees is an average of 3 per forest acre, but actually some large areas are almost devoid of pole timber while other areas are heavily stocked. The second-growth uncut stands of the loblolly pine-hardwoods type contain most of the poles, particularly those stands located between the Roanoke and Chowan Rivers. Because of the high proportion of short lengths the present distribution of size-classes in the forest does not correspond with industrial usage. The average piece cut in this unit for commercial use in 1937 was 40 feet long, whereas the average piece in the forest is only 25 feet long. It is not safe to assume that the great number of small, short pieces will grow into more desirable sizes, as most of them will be cut for saw timber or pulpwood long before they become attractive to the pole industry.

Table 14. - Total number of pine poles by length and diameter, 1937

D.b.h. of trees (outside bark)	Pole length (feet)						Total	Proportion of total
	20	25	30	35	40	45 or over		
Inches	Thousand pieces							Percent
7.0 - 8.9	2,615	298	74	--	--	--	2,987	24.7
9.0 - 10.9	2,347	1,343	718	170	43	--	4,621	38.2
11.0 - 12.9	674	861	727	420	107	80	2,869	23.7
13.0 - 14.9	35	134	332	535	127	58	1,221	10.1
15.0 - 16.9	--	--	39	90	103	125	357	2.9
17.0 - 18.9	--	--	--	3	12	28	43	0.4
Total	5,671	2,636	1,890	1,218	392	291	12,098	100.0
Percent of total	46.9	21.8	15.6	10.1	3.2	2.4	100.0	

THE INCREMENT OF THE FOREST

In general, the growing stock of a forest is the sum of the volume of all living trees. Specifically, in this report the growing stock includes all live sound trees 5.0 inches d.b.h. and larger. "Forest increment" denotes the *net* volume of wood produced by growth of this forest growing stock.

The Relation of the Elements of Increment

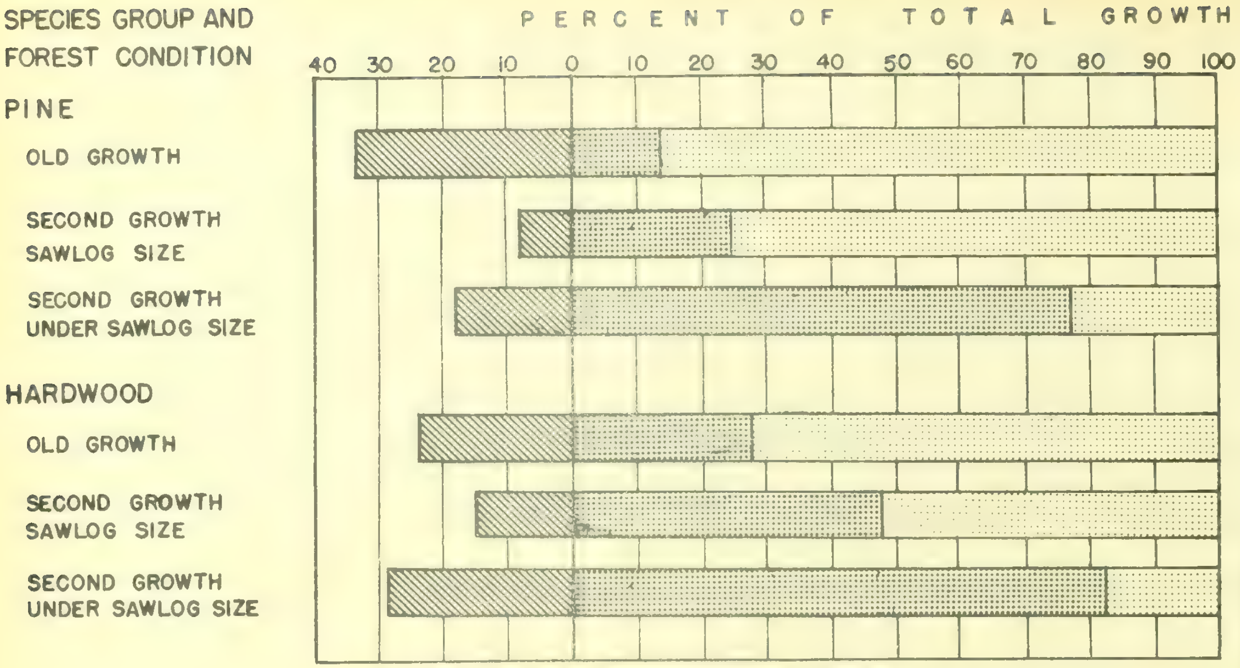
Net increment is the total growth reduced by the amount of mortality. Total growth is composed of 2 major parts, (1) the recruited volume of trees attaining minimum size during the growth period and (2) the volume of growth occurring on the sound trees remaining in the stand. The relative effect of mortality and the two elements of total growth upon net board-foot and cubic-foot increment in the several forest conditions is illustrated in figure 7.

Consider first the pine species-group. In under-sawlog-size stands 77 percent of the total board-foot growth was volume recruited from trees that became of sawlog size during the year. Only 23 percent of the growth was on trees already of sawlog size. Saw-timber stands of second growth had a smaller proportion of recruited volume. Even in the old-growth pine the recruited volume made up about 13 percent of the total growth reflecting the presence of second-growth trees in these stands. By contrast the proportion of volume recruited into the cubic-foot stands (trees 5.0 inches d.b.h. and larger) is much smaller in all conditions.

In the hardwood species-group over 80 percent of the total board-foot growth in the under-sawlog-size stands and nearly 50 percent in the second-growth sawlog-size was recruited volume. The large proportion of recruited volume in the board-foot growth of old-growth hardwoods is a result of the all-aged character of the stand. In contrast to the pines, the proportion of volume recruited into the cubic-foot stands is quite large in all conditions. It signifies a large reserve of small hardwoods that are constantly augmenting the cubic-foot growing stock.

Certain features of mortality deserve consideration. In the second-growth sawlog-size pine stands the mortality, when measured in cubic feet to include the smaller trees, was about double the mortality percent of the saw-timber trees alone indicating a high mortality of small trees. This has a marked influence upon the balance of increment and drain in cubic feet, discussed later in the report. In both the old-growth pines and hardwoods a volume equal to more than 20 percent of the total board-foot growth was lost because of mortality. In the hardwoods this volume loss was compensated by the recruited volume, although the quality of the new board-foot material was probably inferior.

Old age, tree competition, fire, wind, and insects were among the causes of mortality. An example of insect damage was the severe local infestation by the southern pine beetle (*Dendroctonus frontalis*) in Hertford County in 1938 in which an estimated 4 million board feet of old-growth



A-BOARD FEET.

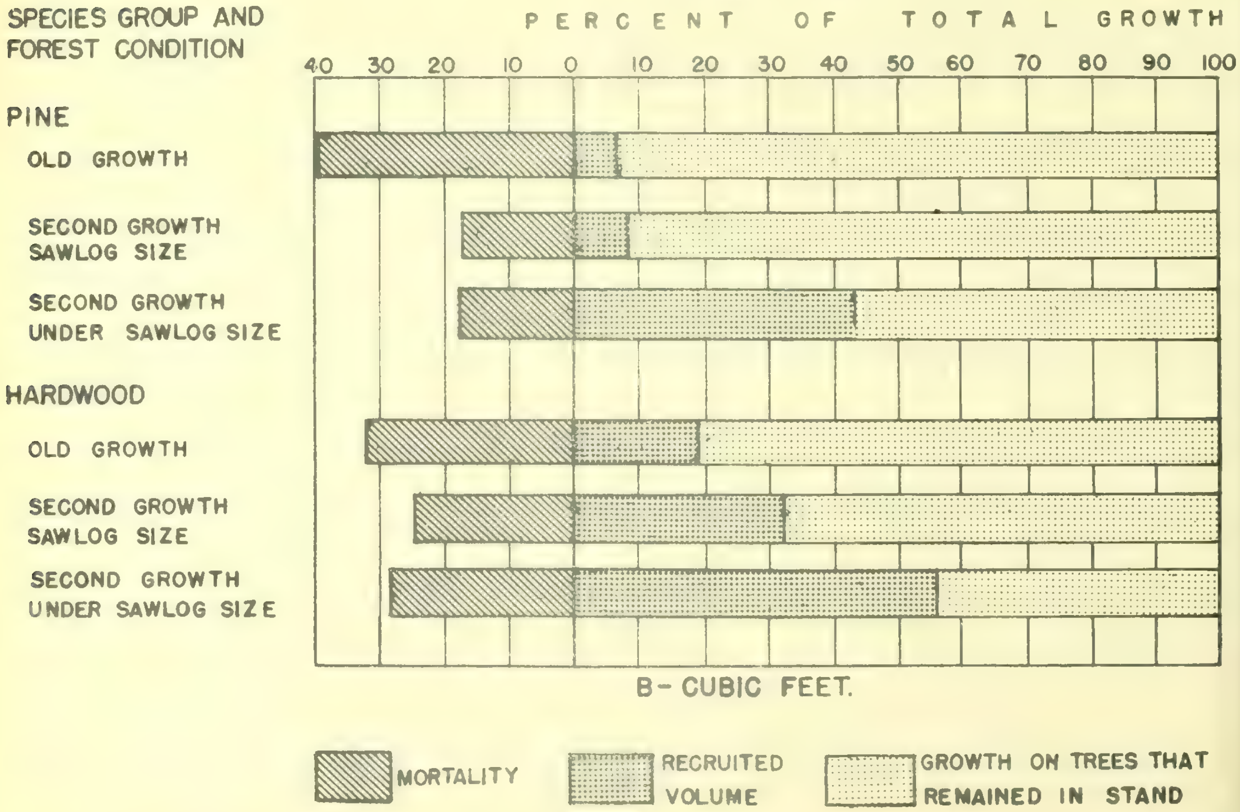


FIGURE 7.-PROPORTIONAL DISTRIBUTION OF THE ELEMENTS OF NET INCREMENT, 1937

pine was killed. Uncontrolled fire is one of the major causes of mortality in all forest conditions but the common practice of blaming all mortality losses upon fire is unjustifiable as trees dying from natural causes are present in practically every forest stand.

Increment of the Total Stand

The increment of saw-timber material in 1937 amounted to 474 million board feet of pine and 175 million feet of hardwoods, a total of 649 million feet. About three-fourths of all the increment developed in second-growth sawlog-size stands. The increment of all sound trees 5.0 inches d.b.h. and larger amounted to 1.3 million cords of pine and 757,000 cords of hardwood, equivalent to 137 million cubic feet of wood without bark. Twelve percent of the cordwood increment was in old-growth stands, 70 percent in second-growth saw-timber, and 18 percent in under-sawlog-size stands.

Increment per Acre

The average increment per acre by forest condition (table 15) is given for 1938 because that is the year for which the most reliable estimates of timber volume by forest condition are available. In arriving at these values no reduction has been made for timber cut during the year, so the increment represents the natural yearly increase of stands in the various forest conditions and types.

This unit has a higher average increment per acre than any other Coastal Plain unit in North or South Carolina. Better soil and climatic conditions are not entirely responsible as there is little variation between units. The higher increment is rather a reflection of the larger volume of growing stock per acre -- in this unit 3,540 board feet compared to 2,200 in the Southern Coastal Plain of North Carolina and about 3,200 feet in the Coastal Plain of South Carolina. Opportunities for increasing the increment exist on much of the forest land, but it is distinctly favorable to find 15 percent of the forest area (second-growth uncut loblolly pine-hardwoods) producing annually nearly 400 board feet per acre, which is good growth even for a managed forest.

Less favorable is the almost negligible increment occurring in the clear-cut condition which occupies almost 4 percent of the forest land. Stocking and increment can be increased by fire protection and natural reseeding on some areas, on others planting will be necessary. Increment is likewise small in the reproduction condition but this is to be expected until the young seedlings become larger. When the reproduction grows into the under-sawlog-size condition, an increment similar to that occurring in the present under-sawlog-size stands can be expected. This amounts to about three-tenths of a cord per acre, which is about the usual average in under-sawlog-size stands throughout the South. In all forest conditions there is an opportunity to increase the increment by increasing the amount of growing stock per acre.

Table 15. - Average increment per acre classified according to forest condition and forest type, 1938

Forest condition	Saw-timber material					All sound trees in all types	
	Loblolly pine-hardwoods	Pond pine-hardwoods	Upland hardwoods	Bottom-land hardwoods	Average of all types	Including bark	Excluding bark
	- - - - - - - -	- - -	Board feet	- - -	- - - - - - - -	Cords	Cu.ft.
Sawlog size:							
Old growth:							
Uncut	160	31	179	211	177	.37	25.7
Partly cut	239	113	104	155	174	.50	35.2
Second growth:							
Uncut	380	156	126	199	293	.80	55.0
Partly cut	234	111	127	171	215	.62	42.3
Under sawlog size:							
Second growth	62	27	35	51	47	.34	22.4
Reproduction and clear-cut	8	2	2	1	3	.01	.8
Weighted average	237	50	83	137	163	.50	34.4

The loblolly pine-hardwoods type had the largest average increment per acre and also the largest average increment in the second-growth uncut condition. The bottom-land hardwoods type ranked next in productiveness, and the increment of its old-growth uncut condition exceeded the increment occurring in the same condition of the loblolly pine-hardwoods type. It is popularly believed that old-growth hardwood stands in the south and southeast do not add net annual increment. Such an assumption may be true in the relatively scarce virgin stands containing only over-mature timber. Old-growth hardwood stands, as defined and classified by the Survey, include not only these virgin stands but more typically the uneven-aged stands dominated by trees having the characteristics of old-growth timber. The presence of younger age-classes in the old-growth hardwoods results each year in a recruited volume alone (fig. 7) that frequently more than compensates for the mortality loss in the older trees. As a consequence, there is a net annual increment accumulating on the sawlog-size trees, a normal circumstance that has been demonstrated in many survey units. Least productive was the pond pine-hardwoods type. Its average increment of 50 board feet per acre measures the annual yield on 22 percent of the forest land.

THE PRIMARY FOREST INDUSTRIES

The forest resource provides raw material for a large number of wood-using plants, and also supplies wood for crossties, poles, firewood, and other miscellaneous products. The lumber industry is most important but the production of pulp and paper, furniture and package veneer, and slack cooperage is of consequence in certain localities.

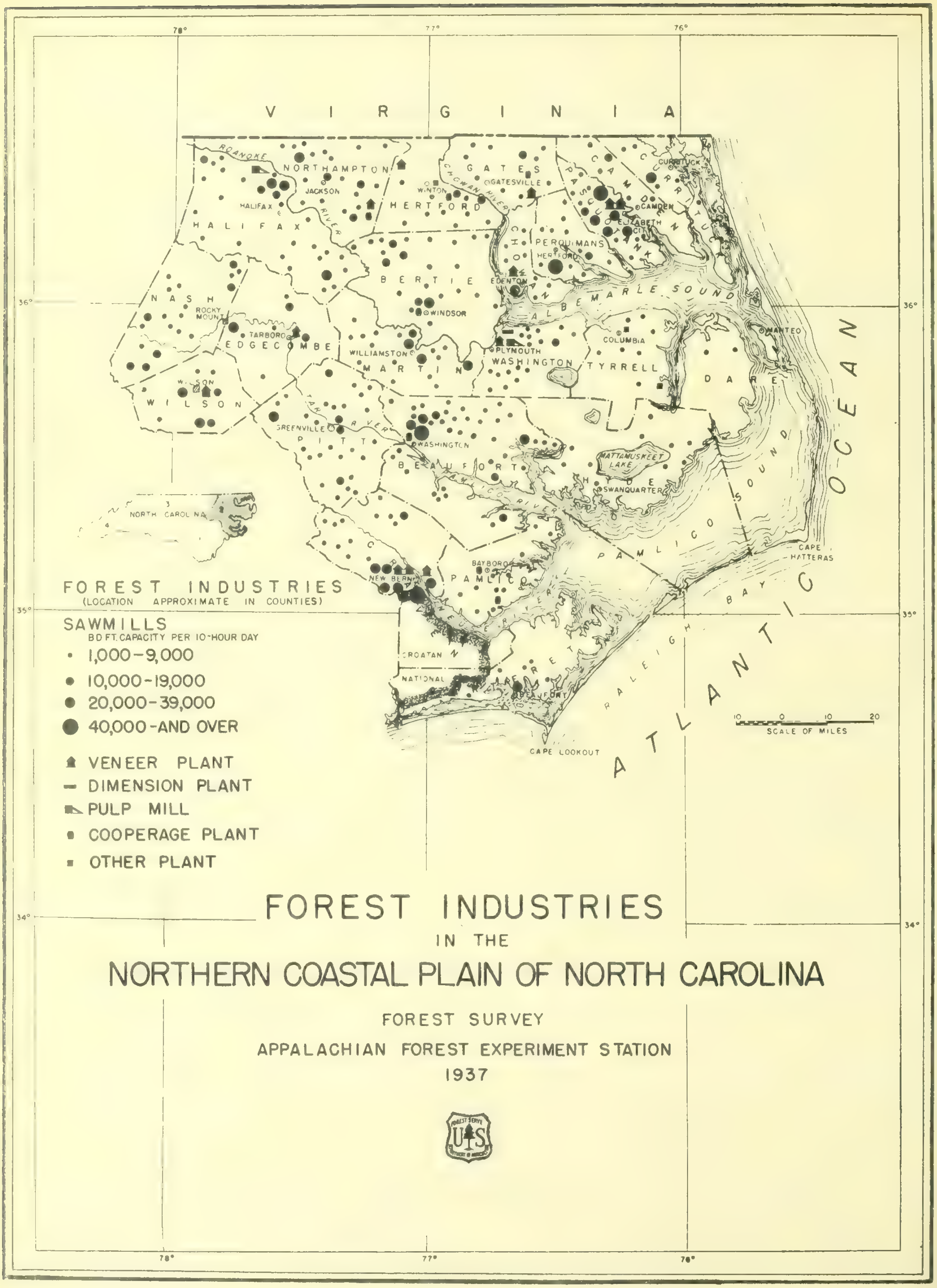
The Lumber Industry

In 1937 the 335 sawmills operating in the unit produced 347 million board feet of lumber, including sawed crossties. About 80 percent of the lumber was pine, 15 percent mixed hardwoods, and 5 percent cypress and white cedar. Three-tenths of the pine, two-thirds of the hardwood, and three-fourths of the cypress and white cedar were cut from old-growth stands. Sixty percent of the total lumber production was obtained from second-growth timber. About 15 million board feet of pine and 3 million feet of hardwood sawlogs were brought into the unit from the Southern Coastal Plain and the Piedmont of North Carolina but 30 million feet of pine and 12 million feet of hardwood and cypress were shipped outside, chiefly to Franklin, Suffolk, and Norfolk in Virginia.

Table 16. - Descriptive summary of lumber production in sawmills of various size-classes, 1937

Item	Capacity in thousand board feet per 10-hour day				All mills
	1 - 9	10 - 19	20 - 39	40 and over	
Number of sawmills	267	37	27	4	335
Avg. 1937 production per mill (M bd.ft.)	296	1,405	5,096	19,600	1,036
Total production of pine (M bd.ft.)	69,300	40,100	105,400	65,800	280,600
Total production of hardwood (M bd.ft.)	9,700	11,900	32,200	12,600	66,400
Avg. no. of days worked per mill	100	214	252	275	123
Avg. no. of men per sawmill	5	15	47	100	11
Avg. no. of men per woods operation	4	11	26	80	8
Percent of mills using:					
Circular saws	100	95	30	0	93
Band saws	0	5	70	100	7
Resaws	Negl.	30	45	100	8
Edgers	65	95	100	100	72
Planers	40	75	70	100	47
Dry kilns	5	50	65	100	16

In 1937 there were only 5 sawmills operating in North Carolina that had a cutting capacity of more than 50,000 board feet per day. Four of these mills were located in this unit, at Washington, Elizabeth City, New Bern, and Hertford (figure 8). These 4 large mills cut 23 percent of the lumber produced in the unit. They are more completely equipped than the smaller mills (table 16) for the manufacture of good-quality lumber.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CAMDEN
CURRITUCK
ELIZABETH CITY
PERQUIMANS
HERTFORD
CHOWAN
EDENTON
BERTIE
WINDSOR
ALBEMARLE SOUND
NASH
ROCKY MOUNT
TARBORO
EDGECOMBE
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MATTAMUSKEET LAKE
HYDE
SWANQUARTER
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PAMLICO SOUND
CAPE HATTERAS
NORTH CAROLINA
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DIMENSION PLANT
PULP MILL
COOPERAGE PLANT
OTHER PLANT
FOREST INDUSTRIES
IN THE
NORTHERN COASTAL PLAIN OF NORTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1937

Figure 8

The 27 sawmills with a capacity of 20,000 to 40,000 board feet per day produced 40 percent of the total lumber cut and nearly half of all the hardwood. These mills have a full complement of up-to-date equipment and their general design is correlated to the production of well-manufactured lumber from second-growth trees. Most of the mills without planers in this size-class are cutting hardwood which is sold unfinished. Slightly over half of the logs for these mills were purchased at the mill yard, 10 percent were cut from land owned by the lumber companies, and the rest were bought as stumpage.

Only 15 percent of the lumber was produced by sawmills in the 10,000 to 20,000 board-foot capacity class. Practically all of these mills use circular saws, otherwise their equipment compares favorably with that in mills of the next larger size-group. The 267 small mills cutting less than 10,000 board feet per day cut nearly one-fourth of the lumber. They operated the fewest number of days and had the least equipment. A surprising number of them had small planers but almost two-thirds of their production was sold rough. Both groups of mills buy standing timber to supply about 70 percent of their needs, logs purchased at the mill provide for 20 percent, while 10 percent of their production was contract or custom sawing.

The lumber industry holds an advantageous position in this unit. Pine lumber commands a net mill price higher than that produced in the deep South because of its nearness to the consuming markets of the large eastern cities. Good roads and truck transportation make it possible to deliver from sawmills and concentration yards direct to construction projects in Washington, Baltimore, or Philadelphia, with economies in transportation that benefit both the producer and consumer. The furniture factories of North Carolina also provide a convenient market for hardwood lumber. Since they are able to use random sizes the hardwood sawmills can obtain a higher degree of utilization than usual.

Other Forest Industries

Seven package veneer plants were operating in this unit in 1937. Their primary product was single-ply veneer which most of the plants fabricated into baskets, crates, and vegetable boxes. The total wood consumption of the mills amounted to 30 million board feet; one-fourth pine and the rest chiefly red, black, and tupelo gum. Practically all of the pine and at least one-third of the hardwood were cut from second-growth timber. About two-thirds of the log volume was purchased delivered at the yard.

The production of furniture veneers and plywood is relatively unimportant in this unit, only five plants operating in 1937. They used about 10 million board feet of second-growth and one-half million feet of old-growth gum and yellow poplar logs, about two-thirds of which were purchased delivered at the yard. There are no furniture factories of consequence in this unit but a nearby market for furniture plywood is available in some of the 125 factories operating in the Piedmont of North Carolina.

Other plants using saw-timber material include seven cooperage plants, three shingle mills, one handle plant, and one plant making sawn posts and mine props. They used about 14 million board feet of sawlogs. Slack cooperage was made from second-growth pine with the average log about 10 inches in diameter. The shingle mills used second-growth pine and a small amount of white cedar. Ash was used for practically all of the handles. The posts and mine props were cut from pine and cypress, and were treated by the cap-end pressure process.

The pulp and paper industry was represented by two mills, one at Plymouth and one at Roanoke Rapids. Production began at Roanoke Rapids in 1907, this plant being one of the earliest producers of kraft pulp in the South. The Plymouth mill is one of the numerous plants built in the South since 1935. It attained full operation in 1938 and at present (1940) it is practically doubling its facilities for producing sulphate pulp. Second-growth pine is used in both plants, and these two plants plus a third one in Virginia, purchased about 42,000 cords in this unit in 1937. Since the Plymouth mill has achieved full production, an increased volume of pine wood has been purchased as well as some black and tupelo gum.

Products cut from the forest and sold without further manufacture included 135,000 pine poles and piles, 53,000 hewn crossties, 270,000 board feet of mine props, and 295,000 board feet of export logs. Most of the poles and piles were purchased by treating plants in Portsmouth and Norfolk, Virginia. Public-carrier railroads used about 10,000 of the cross-ties and logging railroads the remainder. The mine props of unseasoned pine were shipped to coal mines in Pennsylvania. They varied from 9 to 27 feet in length and from 8 to 16 inches in diameter. The export logs, shipped from Norfolk, Virginia, contained high-quality hardwood veneer and saw-timber material.

About 1,077,000 cords of fuelwood and 42,000 cords of miscellaneous material were cut and used locally. Of the fuelwood, about two-thirds were pine and one-third mixed hardwoods. Fuelwood used in homes, schools, and small commercial establishments amounted to three-fourths of the total, while wood used in curing tobacco accounted for the rest. Fence posts, tobacco barns, and peanut stakes comprised most of the miscellaneous material used on farms. Peanuts are an important crop in the northern counties, and many thousand stakes were used. Peanut stakes are 6 to 8 feet long and about 2 inches in diameter. Round pine or gum saplings are most frequently used, although a small proportion are split from 5- or 6-inch pine trees.

Employment

Nearly three million man-days of labor were expended in the primary forest industries in 1937 (table 17). Work in the woods and mills for a cash wage amounted to 1.6 million man-days, or 55 percent of all employment. The remainder, 1.4 million man-days, was utilized chiefly in the production of fuelwood for home use and consequently returned little direct cash income to the individual wood-cutter.

Approximately 5,000 wage-earners were employed in the various primary forest-products plants. About 3,000 of these worked in sawmills, 1,400 in veneer plants, and the remainder in cooperage, pulp, handle and shingle mills. Wood procurement for the forest industrial plants and the production of crossties, poles, mine props, and export logs required the services of at least 4,000 more workers, fully 70 percent of whom were engaged in the lumbering industry. At 25¢ per hour these commercial forest activities would return about four million dollars in wages to the 9,000 or more woods and mill laborers of this unit. With the present minimum hourly wage scale of 30¢ they would have received about one million dollars more, assuming the continued operation of all the forest industrial plants when confronted with a 20 percent increase in labor costs.

Table 17. - Production and employment in the primary forest industries, 1937

Kind of plant or commodity	Number of plants	Material cut in woods	Produced or used by plants	Employment provided		
				In woods	In plants	Total
	- - -	M bd.ft.	- - -	- -	Thousand man-days*	- -
Sawmills	336	371,900	347,000	509	631	1,140
Furniture veneer	5	19,200	10,400	36	41	77
Package veneer	7	45,300	29,900	85	116	201
Cooperage	7	10,400	10,400	27	33	60
		M pieces				
Hewn crossties	--	65	--	9	--	9
Poles and piles	--	135	--	30	--	30
		M cords				
Fuelwood	--	1,076	--	1,291	--	1,291
Misc. manufacture**	7	53	50	54	77	131
Misc. farm use	--	42	--	47	--	47
Total	361	--	--	2,088	898	2,986

*Based on a 10-hour day.

**Includes 2 pulp mills, 3 shingle mills, 1 handle plant, 1 making mine props, and export logs.

Commodity Drain

The commodity drain from the pine and hardwood sound-tree growing stock includes both the material utilized and the sound merchantable material left in felled trees. The drain on the saw-timber portion of the trees, including both the utilized and wasted portions, is expressed in board feet whereas the volumes given in cubic feet and cords include drain on saw-timber material, upper stems of sawlog-size pines, and small trees ranging from 5.0 inches d.b.h. to sawlog-size. The small drain on hardwood tops is not included.

In 1937 the drain of saw-timber material amounted to 578 million board feet (table 18). Forest industries and domestic consumers in the unit used 502 million board feet, 69 million feet were shipped outside the unit, and about 7 million board feet were left unutilized in felled trees in the woods. An additional 19 million board feet were used by the local forest industries, but this volume was obtained from other forest areas in North Carolina. About 70 percent of the total board-foot drain was pine, the remainder mixed hardwoods and a small amount of cypress and white cedar. Two-thirds of the total drain was cut from second-growth timber stands.

Table 18. - Commodity drain from the sound-tree growing stock, 1937

Commodity	Saw-timber material			All sound trees*		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	- Thousand board feet -			- Thousand cubic feet -		
Lumber	295,700	76,200	371,900	55,800	12,670	68,470
Veneer	8,600	61,300	69,900	1,620	9,950	11,570
Cooperage	10,400	--	10,400	1,960	--	1,960
Crossties	600	1,100	1,700	110	280	390
Poles and piles	14,100	--	14,100	2,670	--	2,670
Pulpwood	8,800	--	8,800	2,870	--	2,870
Fuelwood	74,400	17,900	92,300	25,770	12,970	38,740
Misc. manufacture	1,100	4,000	5,100	210	660	870
Misc. farm use	2,300	1,600	3,900	1,280	830	2,110
Total	416,000	162,100	578,100	92,290	37,360	129,650

*Total drain from the growing stock expressed in cords of wood with bark: pine 1,286,400; hardwood 549,200.

Eighty-three percent of the total cubic-foot drain was obtained from saw-timber trees. Three-tenths of the total cut was taken from old-growth stands, six-tenths from sawlog-size growth, and one-tenth from under-sawlog-size stands. About half of the drain was caused by the lumber industry, and 30 percent by the local demand for fuelwood. Nearly half of the fuelwood requirement was obtained from cull trees, hardwood tops, and sawmill waste and was not included as commodity drain, otherwise the fuelwood drain upon the growing stock would have been nearly as great as the drain for lumber.

COMPARISON OF INCREMENT WITH COMMODITY DRAIN

A continuous supply of wood for existing and prospective forest industries is contingent upon a favorable balance between net increment and commodity drain. It is good forest economy, however, to increase production when market conditions are good and to build up the growing stock when prices and demand have fallen off. Consequently the balance of increment and drain for a single year should not be used as an arbitrary criterion of the forest situation. Changes in wood requirements, utilization practices, intensity of fire control, and management practices are a few of the unpredictable factors that may change the whole picture in the space of a few years. Analysis of the specific elements affecting the increment and drain relation in a single year is of value nevertheless, in arriving at an intelligent appraisal of existing conditions.

Comparison in Board Feet

The increment of both pines and hardwoods was more than the commodity drain in 1937 (table 19). Although the pine saw-timber growing stock increased by 58 million board feet, the trend was toward replacement of the old-growth timber with young second growth of poorer quality. The drain in old-growth pine was 3 times the increment, while in sawlog-size second-growth it was only three-fourths of the increment. At the present rate of over-cutting the old-growth pine will soon be reduced to a negligible quantity. The effect upon the wood-using industries will be slight, however, as only a few plants in the unit are operating entirely in old-growth pine. The surplus of increment over drain in the second-growth pine stands is enough to compensate for the over-cut in the old growth and provide a small reserve for building up the saw-timber growing stock.

Table 19. - Balance between increment and drain of saw-timber material, 1937

Item	Pine	Hardwood	Total
	- - - - Thousand board feet - - - -		
Net growing stock, January 1, 1937	9,082,800	5,182,000	14,264,800
Growth, 1937	542,300	216,800	759,100
Mortality, 1937	68,100	41,800	109,900
Net increment, 1937	474,200	175,000	649,200
Commodity drain, 1937	416,000	162,100	578,100
Net change in growing stock, 1937	+ 58,200	+ 12,900	+ 71,100
Net growing stock, December 31, 1937	9,141,000	5,194,900	14,335,900

An increase of 13 million board feet in the hardwood growing stock, which here includes cypress and white cedar, does not, of itself, indicate a propitious situation. The multiplicity of hardwood species of varying quality and current utilization practices are important factors influencing the increment and drain relation of hardwoods in this unit. Increment is calculated for all species, several of which contribute only infrequently to the commodity drain. For instance, black and tupelo gums make up one-third of the hardwood saw-timber volume and a large share of the total increment, but industrial use of these species is relatively small. In effect, the better-quality red and white oaks, red gum, ash, yellow poplar, and cypress are being overcut and the less valuable water and post oaks, black and tupelo gums, bay, and elm are making up an increasing proportion of the stand. Furthermore, the old-growth timber is being cut about twice as fast as it is growing and the second growth replacing it is not equal in quality. Eventually the forest industries will be affected, for at present about two-thirds of the hardwood drain is cut from old-growth stands.

Comparison in Cubic Feet

The total sound-tree growing stock, 5.0 inches d.b.h. and larger, increased by 7 million cubic feet in 1937, but the pine component of the forest decreased by 4 million cubic feet (table 20). It is rather unusual to have the pine saw-timber volume increasing (table 19) and at the same time have the total pine stand decreasing. Figure 7 provides one explanation of this seeming inconsistency. Because of its great volume and the large drain upon it, the second-growth sawlog-size condition has a controlling influence upon the balance of increment and drain. Growth of the board-foot growing stock in this condition is augmented by a considerable recruited volume, while growth of the cubic-foot growing stock is bolstered by very little recruited volume. Furthermore, the mortality lost from the cubic-foot growth is proportionately twice the loss from the board-foot growth. This combination of proportionately small recruited volume and high mortality is the major cause of the small deficit in the pine cubic-foot growing stock.

Table 20. - Balance between increment and drain of all sound material, 1937

Item	Pine	Hardwood	Total
	- - - - Thousand	cubic feet	- - - -
Net growing stock, January 1, 1937	2,234,890	1,666,320	3,901,210
Growth, 1937	109,030	66,420	175,450
Mortality, 1937	20,980	17,800	38,780
Net increment, 1937	88,050	48,620	136,670
Commodity drain, 1937	92,290	37,360	129,650
Net change in growing stock, 1937	-4,240	+11,260	+7,020
Net growing stock, December 31, 1937	2,230,650	1,677,580	3,908,230

In spite of the large quantity of small hardwoods used for fuelwood, there was an increase in the hardwood growing stock. Drain exceeded increment in the old-growth stands, but it was less than half the increment in second-growth stands. The accumulating second-growth material is entirely suitable for fuelwood, the second largest use of hardwood, but much of it is unsatisfactory for saw timber. To prevent the constant deterioration of the hardwood stands lumbermen should make every effort to utilize as many species as possible and farmers should cut their fuelwood from the least desirable species and poorest-quality trees.

Comparison in Cords

A comparison in cords (fig. 9) finds total growth of both pines and hardwoods materially in excess of commodity drain. Mortality drain was an important item, however, and cordwood and saw-timber losses from this cause were great enough to occasion a decrease of 17,000 cords in the pine growing stock. A large part of this pine mortality was in second-growth saw-timber stands providing material eminently suited for pulpwood. Overcrowded stand conditions and forest fires, both factors that can be corrected with more intensive forest management practices, were responsible for most of the mortality losses. Reduction of pine mortality loss is especially desirable in view of the probable increase in commodity drain when the enlarged Plymouth pulp mill goes into production.

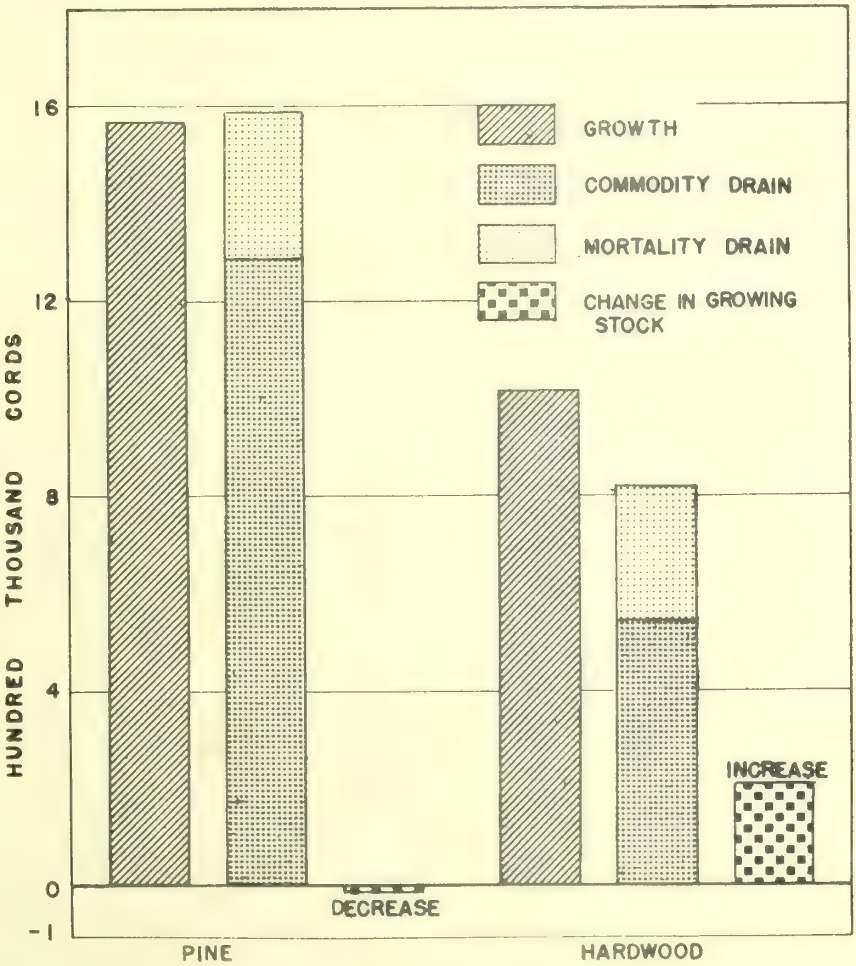

FIGURE 9.- COMPARISON OF GROWTH WITH MORTALITY AND COMMODITY DRAIN, 1937

FAVORABLE ASPECTS OF THE FOREST SITUATION

Although the forest situation can be improved materially, it has at least two favorable features worthy of mention: the character of the forest stand and the diversity of markets for forest products.

Character of the Stand

Nearly two-thirds of the forest land is stocked with commercial saw-timber stands that average 5,500 board feet per acre. It is profitable to both timber-land owners and forest industries to have such large average volumes per acre on so much of the forest land. Increment is likewise high, averaging 163 board feet per acre for the entire forest. The second-growth uncut forest condition, which occupies about one-fourth of the forest, has an increment rate of nearly 300 board feet per acre. Furthermore, about half of the forest land is occupied by the loblolly pine-hardwoods type, the most important type from the standpoint of industrial supply and profitable forestry. Its sawlog-size stands have an average volume of 5,970 board feet per acre and the increment is as high as 380 board feet per acre in the second-growth uncut stands. Forest problems exist to be sure, but for most of the forest stand, they involve making better what is already reasonably good.

Markets

The location and diversity of markets for forest products favor timber production. The large consuming centers of the Northeast, including Philadelphia and New York, are within truck haul of this unit. Transportation costs are lower than for producing areas farther south, so that a larger margin is left for stumpage or manufacturer's profit. The furniture industry in the nearby Piedmont area of North Carolina provides a market for hardwood lumber as well as for hardwood furniture veneers and plywood. A market for pine cordwood is available at the two pulp mills in the unit, and at several pulp mills in Virginia. There is also a demand for hogsheads, boxes, crates, and baskets in which to market tobacco and truck crops. These varied markets provide a strong incentive for timber growing.

FOREST PROBLEMS AND REMEDIAL MEASURES

Under existing conditions of forest use the pine cubic-foot growing stock is decreasing in volume and the hardwood stand, while increasing, is building up a surplus of increment only in the less valuable species. Fire protection is lacking on one-third of the forest land, the growing stock is deficient in total volume and size-class distribution, and there are large areas of denuded pond pine land. These unfavorable aspects of the forest situation warrant more detailed comment.

Forest Fires

Forest fires are a serious deterrent to the attainment of increased forest production. The North Carolina Division of Forestry has most of the Western Coastal Plain counties under protection and forest fires are held within reasonable limits. Intensification of fire control is desirable in these counties but the greater need is for the extension of organized protection to the 10 unprotected counties in the Tidewater portion of the unit. Forests are of especial importance to the inhabitants of these counties, and in several of them fire has damaged the timber stands severely. The pond pine-hardwoods type has suffered particularly from fire, and it is safe to say that productive use of about one-fourth of the forest land in the unit depends primarily upon the control of fire in this type.

The present system of fire control is based upon the use of state and federal funds to provide state cooperation with the county governments in the form of county protective units, and with private individuals in the form of private protective associations. The State Division of Forestry has charge of all protection activities in both the county and private associations. In the period between 1921 and 1938 the non-federal forest land under organized protection in the State has been increased from 675,000 acres to 12 million acres. The burned area in the 1937-38 fiscal year was only 1.7 percent of the protected acreage. With this experience and efficiency the Division of Forestry can extend fire control to the 10 unprotected counties in this unit as fast as sufficient funds are obtained to finance the protective organization. These counties contain approximately 1.5 million acres of forest land. Intensive fire protection would cost about $65,000 per year, but protection equivalent to that in the remainder of the unit could be provided for about $25,000 per year.

Deficiency of Growing Stock

The growing stock is incomplete because it is deficient both in total volume and in size-class distribution. The pine types average less than half of full stocking (table 6) and the hardwood types are comparable. Growing-stock volume in the pond pine-hardwoods type is especially small. Another fault of the pine growing stock is the relative scarcity of the smallest diameter classes. In the total pine stand the ratio of 4-inch to 6-inch trees is 1.2 to 1.0, and in the 6- to 8-inch trees it is 1.3 to 1.0. Ratios in other survey units with a better distribution of small trees approximate 1.8 to 1.0 and 1.6 to 1.0, respectively.

It will be impossible to obtain full stocking on every forest acre. To the extent that it is possible, the forest will contribute that much more raw material for industry and employment for labor. Improvement in stocking depends upon the adoption of better forest practices by the individual land-owner. Forest fires should be controlled, open spaces in the stand should be restocked artificially or naturally with skillful handling of seed trees and soil, abandoned fields should be planted if natural restocking is not satisfactory, thinnings should be made at intervals to maintain fast growth and the cut should be restricted to less than the increment until the desired stocking is obtained. These measures would increase the proportion of young pines in the stand, but adequate restocking also should be assured by harvesting methods designed specifically to aid in re-establishing a forest cover.

Denuded Areas

The large areas of denuded pond pine land locally known as "lights" or "open land" are so extensive and unproductive that they influence the economy of whole counties. Dare County is affected most, but Hyde, Tyrrell, and Carteret Counties suffer from the presence of extensive acreages of these non-producing lands. The "open lands" are relatively inaccessible, except along the watercourses, and frequent fires burn unchecked in the heavy cover of brush. The soil is naturally poor and fires have further destroyed its fertility. Establishing a forest cover will be difficult and it is doubtful whether these areas should be considered potential commercial forest lands.

Any program designed to improve conditions upon these denuded lands must recognize their unsuitability for agricultural use. Timber or game production seem to offer the best possibilities. In either case complete fire control is the first step. Planting will be necessary on more than 100,000 acres to restock the area with timber. Before a large-scale planting program is decided upon, research is needed to determine possibilities, methods, species, and planting costs. Because of the expense and long-time nature of the project some form of public ownership may be necessary if restocking is considered beneficial to the public interest.

Developing the game resources of these lands appears to be a possible solution. A definite game propagation and exploitation program could be developed without exhorbitant expense and such a program would increase the revenue from the denuded lands. Deer and bear hunting in these unique coastal areas could become an important attraction especially when coordinated with the wild fowl hunting upon the Swanquarter and Mattamuskeet Wildlife Refuges in Hyde County.

Management of Pond Pine

Very little is known concerning the management of pond pine. Reliable information is needed in this unit, where the pond pine type occupies 22 percent of the forest land. Some of the pulp companies, larger lumber companies, and investment owners, holding thousands of acres of pond pine, wish to adopt management practices that will provide a greater and better quality yield of wood. At present they are not sure of the correct procedures.

The basic need is for scientific study of the many problems by competent men trained in technical forest research. Experimental plots should be established in the pond pine type so that methods can be worked out and checked under actual forest conditions. Woodland owners are now asking should pond pine pocosins be drained? -will light burning of the ground cover open fallen seed cones satisfactorily? -will the sun open cones that are on lopped and scattered tops? -must the top layer of the soil be burned off for the seedlings to survive? -and how can the open spaces in pond pine stands be restocked naturally? The field and demand for research in the management of pond pine extends all the way from soil treatment to the harvest cuttings in mature stands.

Utilization of Hardwoods

Two undesirable conditions result from present practices of hardwood utilization. Concentrating the cut upon old-growth timber of a few species has the effect of high-grading the timber stand both as to species and quality. It results in removing the best material much faster than it is being replaced. Greater immediate profits may accrue to the hardwood industries but such a policy will shorten their lives. Ways and means must be found to make profitable use of the lower-quality second-growth hardwoods. High-grade well-equipped hardwood dimension mills offer one solution. Such mills practice close utilization, manufacture their product with especially designed equipment to meet U. S. Bureau of Standards commercial specifications, use a variety of hardwood species, and produce a refined product that has a higher market value than lumber.

Partly because of the narrow range of hardwood utilization, there has developed a great quantity of black and tupelo gum not being utilized in proportion to its rate of increase. Sound trees of these species contain 10 million cords and cull trees contain over 3 million cords, a total volume of sound material that amounts to 18 percent of the cordwood volume in the unit. This immense volume of material should contribute more to the forest economy of the unit through increased use by industry. One of the pulp mills in the unit plans to use gum for a part of its requirements. The available supply justifies its use by other pulp mills that draw upon this territory. Lacking an expansion of use by existing mills, there is an opportunity for a new pulp mill that will use gum as raw material. Also, hardwood dimension mills can now utilize both black and tupelo gum because of improvements in kiln-drying and the development of higher speed machinery.

REVIEW OF THE REPORT

Forests constitute one of the major natural resources of this unit. They occupy three-fifths of the land, supply raw material to about 360 manufacturing plants and provide direct employment to about 9,000 workers. Forests are an important adjunct of many farms, providing domestic fuelwood, tobacco-curing wood, rough construction material, and forest products for sale. They also provide a means of returning to productive use the tobacco and cotton land occasionally abandoned. In certain parts of the unit the forest also shelters a considerable game population that is the basis for a small recreation industry.

About 4 million acres of forest land are distributed throughout the unit; 47 percent on rolling uplands or level lowlands, 30 percent in pocosins or swamps, and 23 percent in river bottoms. Loblolly pine is the most abundant species, making up nearly half of the total cubic-foot volume. Pine types occupy nearly 70 percent of the forest area but the less valuable pond pine-hardwood type is found on about one-third of the pine land. Eighty-three percent of the forest is second growth. About 63 percent of the forest land supports sawlog-size stands, 34 percent supports under-sawlog-size stands, and 3 percent is clear-cut. The total saw-timber volume is 14.3 billion board feet, about two-thirds pine and one-third hardwoods. There are 73.1 million standard cords of wood with bark or 4.9 billion cubic feet of wood only. Increment amounted to 649 million board feet, 2.0 million cords, or 137 million cubic feet. The average increment per acre was 163 board feet of saw timber or one-half a cord of all sound material.

Fully 360 forest industrial plants operated in 1937. These included 335 sawmills, 12 veneer mills, 7 cooperage plants, 2 pulp mills, 3 shingle mills, a mine prop plant and a handle plant. About one million cords of fuelwood, 372 million board feet of sawlogs, and 75 million feet of veneer and cooperage logs were cut, as well as smaller quantities of crossties, poles, pulpwood, mine props, shingles, export logs, and handle stock. The forest resource thus provided 3 million man-days of employment or full-time work to about 9,000 people. Commodity drain was 578 million board feet of saw timber or 130 million cubic feet of all sound material. The board-foot increment was greater than drain so the forest growing stock increased by 71 million board feet. The cubic-foot increment of pines was less than the drain but a surplus of increment in the hardwoods more than compensated for the deficit, so the forest as a whole increased by 7 million cubic feet.

Although the forest growing stock increased slightly in 1937, there was not enough surplus to justify a general expansion of the forest industries. A few plants to utilize low-grade hardwoods are needed now but other plants cannot be established upon a sound basis until the forest yields are increased. This can be accomplished by improving the present growing stock through more intensive fire control, education of landowners in forest management practices, restoration of denuded areas, research in management of pond pine, and improved methods of timber utilization. These measures should increase the forest yields in the unit as a whole by at least one-half, thus providing for a parallel increase in the forest industries. Because of its favored position in relation to markets this unit can well benefit from an intensified development of its forest resource.

GLOSSARY

General

Forest Survey Unit. -- The term "forest survey unit" denotes an area of 4 to 10 million acres in which topographic, forest, economic, and industrial conditions are reasonably homogeneous.

Land-use Classes

Productive forest area. -- Forest land having qualities essential for the growth of commercial timber.

Nonproductive forest area. -- Forest land lacking qualities essential for the growth of commercial timber.

Cropland, old and new. -- Land used for production of farm or orchard crops or evidently so used during the past 5 years. This includes new cropland, i.e., land converted from forest to cropland within 5 years prior to survey.

Pasture. -- Cleared or open land under fence used primarily for grazing.

Abandoned cropland. -- Land once cultivated but showing distinct evidence of having been abandoned for agricultural crop production.

Other non-forest. -- Areas included within the corporate limits and surburban or industrial sections of cities and communities; power, rail, and highway rights-of-way; marsh; and nonmeandered waterways.

Forest Types

Loblolly pine-hardwoods. -- Stands in which pines make up 25 percent or more of the dominant and codominant stems with loblolly pine predominating.

Pond pine-hardwoods. Stands in which pines make up 25 percent or more of the dominant and codominant stems with pond pine predominating.

Upland hardwoods. -- Stands in which mixed oaks and other hardwoods make up 75 percent or more of the dominant and codominant stems, usually found on the rolling upland sites.

Bottom-land hardwoods. -- Stands in which hardwoods make up 75 percent or more of the dominant and codominant stems, usually found in river bottoms and swamps.

Diameters

D.b.h. (diameter at breast height). -- Diameter, outside of bark, measured at 4½ feet from the ground.

Diameter class. -- All trees were recorded in 2-inch diameter classes, including diameters 1.0 inch below and 0.9 above the stated midpoint, e.g., trees 7.0 to 8.9 inches d.b.h. are placed in the 8-inch class.

Tree Classification

Sound sawlog-size tree. -- A pine, cypress, or white cedar tree at least 9.0 inches d.b.h., or a hardwood tree at least 13.0 inches d.b.h., with not less than one sound butt log 12 feet long, or with 50 percent of the gross volume of the tree in sound saw timber.

Sound under-sawlog-size tree. -- Any tree over 1.0 inch d.b.h. and less than sawlog-size, with a reasonably straight sound stem.

Cull tree. -- Any tree that fails to qualify as a sound sawlog or under-sawlog-size tree because of form, limbiness, rot, or other defect.

Pole tree. -- Pine trees that will produce a pole conforming to specifications of the American Standards Association.

Forest Conditions

Sawlog Size

Old growth, uncut. -- Stands composed of trees having the characteristics of the original mature timber of the region and containing at least 1,000 board feet per acre of merchantable species in hardwood types, and 600 board feet per acre in pine types, with less than 10 percent of the volume cut.

Old growth, partly cut. -- Old-growth stands from which 10 percent or more of the volume has been cut, leaving a minimum of 1,000 board feet per acre in the hardwood types, or 600 board feet per acre in the pine types.

Second growth, uncut. -- Stands of second growth having at least 600 board feet per acre in trees of sawlog-size, and with less than 10 percent of the sawlog-size trees removed.

Second growth, partly cut. -- Stands of second growth from which 10 percent or more of the sawlog-size trees have been removed but with the remaining stand containing 600 or more board feet per acre.

Under Sawlog Size

Second growth. -- Young second-growth stands in which the volume of timber in trees of sawlog size is less than 600 board feet per acre and the remainder of the trees are below sawlog size.

Reproduction. -- Stands too young to classify as second growth having at least 80 well distributed seedlings per acre.

Clear-cut. -- Cut-over areas having insufficient young growth to qualify either as second growth or reproduction.

Volume Estimates

Board-foot volume. -- Only the saw-timber portion of sawlog-size trees are included in this estimate. Top diameters vary with the limits of usable material. Deductions are made for woods cull and for loss in sawing at the mill.

Cordwood volume. -- This volume (including bark) is derived from the following sources:

1. The sawlog portion of sawlog-size trees.

2. The portion of saw-timber trees not usable as sawlogs but acceptable as cordwood. This includes the upper stems of pine and cedar and, unless otherwise noted, the upper stems and limbs of hardwoods and cypress. The minimum diameter limit is 4.0 inches outside bark.

3. The full stem of sound under-sawlog-size trees, at least 5.0 inches d.b.h., to a variable top diameter not less than 4.0 inches outside bark.

4. The estimated sound material in cull trees.

Deductions for cull include only the volume in defects which cause the material to be unsuited for cordwood. Sweep and slight crook are not regarded as defects.

Cubic-foot volume. -- This volume is derived from the same sources as the cordwood volume except that bark is not included.

Standard cord. -- A stacked pile of round or split wood bolts measuring 4' x 4' x 8' and estimated to contain 90 cubic feet of wood and bark in the pine, cedar, and cypress species, and 80 cubic feet of wood and bark in the hardwood species.

Increment

Growing stock. -- The sum of the volumes of all sound trees 5.0 inches d.b.h. and larger; dead and cull trees and tops of hardwood and cypress not included.

Board-foot increment. -- Includes the net growth on the saw-timber portion of sawlog-size trees, plus the volume in sound trees reaching sawlog-size.

Cordwood increment. -- Includes the net growth on the sound stemwood of pines and cedar 5.0 inches d.b.h. and over, on under sawlog-size hardwoods and cypress, and on the sawlog portion of sawlog-size hardwoods and cypress, plus the sound-tree volume of all species reaching 5.0 inches d.b.h. during the increment period.

Cubic-foot increment. -- Omits bark volumes, otherwise material is identical with cordwood.

Mortality

Mortality. -- The volume lost from the growing stock of the forest through the death of individual trees. Natural causes of mortality include lightning, tree competition, old age, disease, insects, drought, and wind. Fire is the major man-caused source of mortality.

FOREST SURVEY RELEASE NO. 6 NOVEMBER 15, 1940

FOREST RESOURCES OF THE PIEDMONT REGION OF NORTH CAROLINA

by

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U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

Appalachian Forest Experiment Station
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PREFACE

Through the McSweeny-McNary Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act, and each of the 12 Regional Experiment Stations was made responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station, Asheville, North Carolina.

The work of the Survey is divided into 5 major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of the timber on these lands.

2. Growth. Determination of the current rate of timber growth.

3. Drain. Determination of the amount of industrial and domestic wood use, and the total loss resulting from fire, insects, disease, suppression, and other causes.

4. Requirements. Determination of the current and probable future requirements for forest products by all classes of consumers.

5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis for public and private policies and plans of forest land use and management.

This progress report presents preliminary information on the first three of these phases for the Piedmont Region of North Carolina, one of the four units into which the State was divided. Similar releases have been published for the two Coastal Plain Units and to complete the State a release for the Mountain Region will be published during this calendar year.

Information on the physical forest resources was obtained by a field survey made in the spring of 1937. In all, 12,737 sample plots were established at intervals of one-eighth of a mile on compass lines 10 miles apart, extending across the unit in a northeast direction. The statistical sample obtained from these plot records forms the basis for all area and volume estimates in this report, except where other sources are directly credited. Owing to the method of sampling, small tabular items have the greater probability of error and should be considered as indicating relative magnitude rather than actual values.

Data on consumption of forest products for industrial and domestic purposes were obtained by canvassing all primary manufacturing plants and a number of representative domestic consumers.

Forest Survey Staff Assisting in the Preparation of this Report

Field inventory	W. E. Houser, In charge
Compilation and analysis of inventory, growth and drain data	G. E. Morrill, In charge T. C. Evans

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FOREST RESOURCES OF THE PIEDMONT REGION OF NORTH CAROLINA

INTRODUCTION

The purpose of this report is to describe the forests and forest industries of the Piedmont Region of North Carolina. Because forests occupy nearly one-half of the land they constitute a resource that cannot be neglected in a well-planned program of land use, industrialization, and social betterment. Accurate and up-to-date data are needed to properly evaluate the relation of forests and forest utilization to the economy of the whole region

To meet this need the report provides a brief description of the present physical, social, and industrial make up of the Piedmont. The forest resource is portrayed in considerable detail and the effect of its utilization upon industry, employment, and land use is set forth. Forest problems are presented and remedial measures suggested. Adjustments in land use, forest production, and forest products utilization are recommended to provide for more complete development of the forest resource.

PHYSICAL CHARACTERISTICS OF THE UNIT

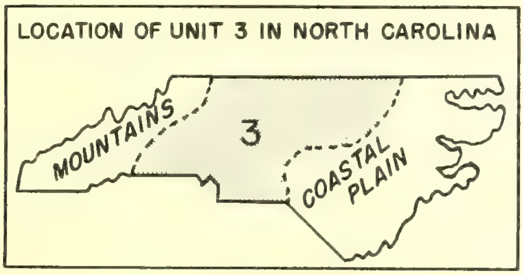

FIGURE 1

North Carolina Forest Survey Unit 3 is composed of 35 counties lying between the mountains on the west and the Coastal Plain on the east. It corresponds as closely as county lines permit with the physiographic boundaries of the Piedmont Plateau. The unit contains 10.6 million acres, approximately one-third the area of the State.

The topography is characterized by rolling hills and valleys, subdued in comparison to the rugged mountains but less monotonous than the level Coastal Plain. Elevations range from 1,000 feet in the northwestern section to about 500 feet along the "fall line" at the eastern edge of the Piedmont.

A large part of the unit contains good agricultural soils. Sandy loams, red clays, and clay loams predominate and the Cecil clay loam and the Cecil sandy loam are the two most extensive soil types. Forests grow on practically all of the soils and they occupy most of the land not used for agriculture.

The most important drainage basins of the Piedmont Region are those of the Roanoke, Tar, Neuse, Cape Fear, Yadkin, Catawba, and Broad Rivers. The Yadkin and Catawba Rivers drain more than half of the Piedmont and are especially important as a source of hydro-electric power.

SOCIAL AND INDUSTRIAL CONDITIONS

The Piedmont supports interrelated urban, agricultural, and industrial life. Scattered throughout its entire area are large numbers of thriving villages and towns and several fast-growing cities. Compared with other southern areas this unit is highly diversified both agriculturally and industrially. Farm products include tobacco, cotton, corn, potatoes, truck crops, and dairy produce. It is the center of furniture manufacture in the South, and leads the nation in the production of cigarettes and textiles. Furthermore no other equal area in the southeast contains so many sawmills and other primary and secondary wood-products plants.

People

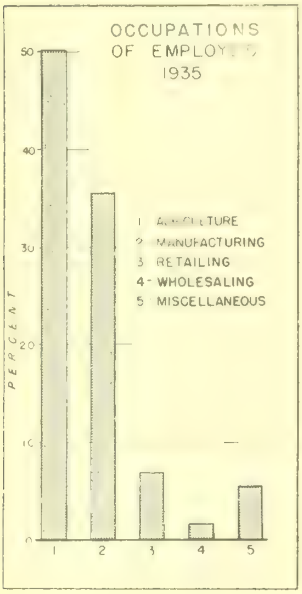

FIGURE 2

About half of the people in the State live in this unit and the proportion is increasing. The population reached 1.5 million by 1930, almost doubling in 30 years. Urban and rural population are in better balance than in most of the Southeast as 35 percent of the population is urban, 42 percent is rural, and 23 percent lives in small towns and villages. This is a result of the rapid industrialization that has taken place since 1900. The growth of several of the cities has been phenomenal. The concentration of the furniture industry at High Point and tobacco manufacturing at Durham caused an eight fold increase in the population of these cities between 1900 and 1930. Charlotte and Winston-Salem, the two cities with more than 75,000 inhabitants, have had a less meteoric growth but nevertheless contain five times as many people as in 1900. The growth of the more industrialized counties has been in part at the expense of the nearby rural counties. This drain has not been great enough to reduce the population of any county, but Alexander, Caswell, Chatham, Davie, Montgomery, and Stokes Counties remained practically constant in population between 1900 and 1930 while Guilford, Forsythe, and Gaston were increasing by 180 percent or more. Industrialization has unquestionably vitalized the Piedmont but half of the 500,000 people gainfully employed in 1935 still depended upon agriculture for their livelihood.

Agriculture

Between 1900 and 1935 the number of farms in this unit increased by 24 percent while the land in farm ownership decreased by about 10 percent. The result has been to reduce the size of the average farm from 95 to 72 acres and to reduce the proportion of full ownership from 55 to 44 percent. According to the Bureau of the Census there were 120,000 farms in 1935, containing 8.5 million acres. The average farm consisted of 35 acres of woodland, 27 of cropland, 5 of pasture, and 5 devoted to miscellaneous uses. The practice of subdividing the farm acreage into more and smaller farms is causing a gradual reduction in the size of the average farm woodland, a trend that may eventually limit farm forest products to little more than fuelwood for home consumption.

The value of crops and livestock produced in 1935 was approximately 85 million dollars, according to data published by the North Carolina Crop Reporting Service. The tobacco crop was valued at 37 million dollars, cotton at 14 million, corn at 13 million, livestock at about 7 million, and miscellaneous crops the remainder. The Census of Agriculture also reported one million dollars worth of forest products sold from farms in 1934. The per-farm value of cash crops harvested was about 450 dollars. By comparison, forest products from farms returned about 90 dollars in cash per farm to the 10 percent of farms reporting sales of forest products.

Manufacturing

The Piedmont of North Carolina has experienced a tremendous industrial expansion since 1900. In the whole State at the beginning of the century there were only 70,000 employees in all manufacturing industries, receiving only 14 million dollars in wages and producing goods valued at 95 million. By contrast, in 1935 the industries of the Piedmont alone gave employment to about 220,000 employees, earning about 100 million dollars, and producing goods valued at close to a billion dollars. The major factor responsible for this industrial growth has been cheap and abundant hydro-electric power, of which large-scale commercial development began about 1900. Ample supplies of raw material such as cotton, tobacco, and forest resources, as well as an adequate supply of labor and nearness to markets were important contributing factors. Within a radius of 500 miles of the center of the Piedmont is half the population of the United States and a majority of the more concentrated urban markets.

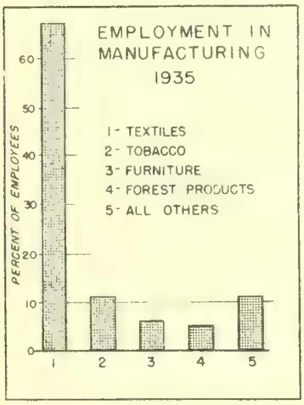

FIGURE 3

Textiles: North Carolina leads the nation in textile production. The Census of Manufactures reported about 640 textile mills in the State in 1935, of which nearly 600 were located in the Piedmont. Gaston, Mecklenburg, and Guilford Counties are important textile producers, and the towel mills at Kannapolis, the hosiery mills at Durham, and the denim mills at Greensboro, rank among the world's largest. Approximately 150,000 people were employed in 1935 in the textile mills of the Piedmont, where they earned about 100 million dollars in wages, and produced goods valued at close to 400 million dollars.

Small quantities of wood products are required by the textile industry. Wooden shuttles, picker sticks, spools, bobbins, cones, cobs, and quill boards are used in the spinning and weaving processes. Part of the wood for the shuttles and picker sticks is cut in this unit. Dogwood is favored for shuttles because it is heavy, hard, and strong and wears smooth with continued use while hickory has been found best for picker sticks. The essential high-quality trees of these species are scattered through the Piedmont and less than 500 cords of dogwood and 100,000 board feet of hickory were cut for these products in 1937.

Tobacco: North Carolina is the leading state in the manufacture of tobacco, specializing in the production of cigarettes and smoking tobacco. Factories at Durham, Winston-Salem, and Reidsville, all in the Piedmont, account for practically all of the State's output. According to the Census of Manufactures the tobacco manufacturing industry furnished employment to about 17,000 people in 1935, who earned 13.5 million dollars and made products valued at 463 million dollars.

The forests of the Piedmont contribute materially to the conduct of the tobacco industry. Forty percent of the United States tobacco crop is grown in North Carolina and about one-third of the State's production is grown in the Piedmont, in 1937 about 180 million pounds. Curing and storing this immense quantity of tobacco requires a large amount of wood, which is cut locally. Firewood is used for curing most of the flue-cured tobacco, the curing leaves are hung upon wooden tobacco sticks in log or wooden-frame curing barns, the tobacco is sold at the markets in wooden tobacco baskets, and is stored in wooden hogsheads. The firewood requirement alone exceeded one-third of a million cords in 1937.

Furniture: The furniture manufacturing industry of North Carolina started at High Point in 1888. It has grown steadily, experiencing especially rapid development between 1914 and 1919. Most of the factories are located in the Piedmont, and High Point, with its large furniture exposition building, is the furniture center of the South. About 14,000 people were employed in the 150 furniture factories of the unit in 1935. They received about 9 million dollars in wages and produced furniture valued at nearly 35 million dollars.

The original establishment of the furniture industry in the Piedmont of North Carolina was due largely to the abundant supply of good-quality oak timber. The hardwood timber supply has not kept pace with the rapidly growing industry, however, and today much of the hardwood must be shipped several hundred miles to the factories. Nevertheless, the local forests provide raw material for about 40 plants making furniture veneers and dimension stock, for the sawmills cutting the estimated 20 million board feet of pine crating material required each year, and for the limited number of sawmills cutting hardwood lumber for furniture use.

Forest products. In addition to furniture factories the Piedmont of North Carolina contains an abundance of wood-using plants. Those using wood direct from the forest are most numerous, numbering about 1,660 in 1937. Small portable sawmills comprise the majority of these establishments but there are more than 50 plants making either veneer, furniture dimension, handle or shuttle blocks, cooperage, or tobacco baskets. These primary forest industries will be discussed in more detail later in the report. Secondary plants that buy semi-finished material for further manufacture, include those making finished lumber, millwork, wooden containers, plywood, and miscellaneous wood products such as coat hangers, wash boards, and toys. Altogether there were nearly 1,750 wood-products plants in 1937. They employed about 10,000 people, exclusive of woods labor, and manufactured products valued at about 10 million dollars.

Power

A description of the Piedmont would be incomplete without brief mention of its power resources. Beginning in 1898 with a small plant in the Yadkin River at Idols, hydro-electric development has proceeded rapidly until today there are 21 plants with a capacity of nearly 500,000 horsepower. Four steam generating plants provide an additional 330,000 horsepower and a fifth one of large capacity is under construction in Rutherford County. Abundant cheap power has been a major factor in the development of the tobacco, textile, and furniture industries. Forest-products industries have made infrequent use of electric power in the past but present-day veneer plants, planing mills, and dimension stock mills are using electricity for power and its use by other wood-products plants will increase as local distribution lines tap more rural communities.

Steam-electric plants are generating an increasing amount of the electric energy used in the Piedmont. They have become remarkably efficient in recent years and it is probable that they will be utilized for new installations in all but the most favorable hydro-electric locations. Water control is a major problem of the existing hydro-electric plants. The forests of the unit have a strong beneficial influence upon stream flow because they reduce flood crests, retard erosion, and check silting of rivers and reservoirs.

Taxation

The assessed value of all real and personal property in the Piedmont amounting to 1.4 billion dollars was 60 percent of the State total in 1937. It was taxed at county-wide rates varying from 48 cents to $2.00 per $100 of assessed valuation and yielded about 11.7 million dollars in taxes. Assuming an average tax of 15 cents per acre on forest land and timber the forests of the unit were the base for about 6 percent of the county taxes.

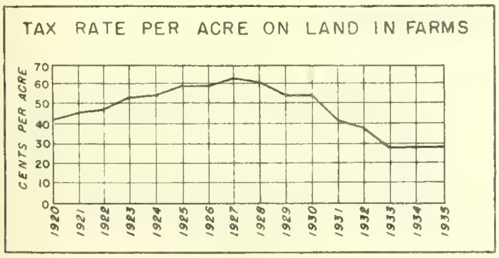

FIGURE 4

Because 85 percent of the forest land is on farms the trend of farm tax rates has a direct bearing upon forest land tax costs. Figure 4 is based upon only 10 counties of the Piedmont but it shows how the tax rates rose steadily during the years of increasing income, and how they fell during the depression years.[1] While the tax rate tends to follow farm income changes there is usually a lag in adjusting it to a declining farm income. Occasionally this causes premature cutting of farm forests in order to obtain money for taxes.

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[1] Forster, G. W. Recent changes in tax rates on farm real estate in North Carolina, N. C. Agr. Exp. Sta., Information Series No. 3, Nov. 1937.

For taxation purposes forest land is generally classified by tax assessors as wasteland, cutover land, woodland, or timber land. Allocation of forest land into these four classes is not uniform among counties. Data obtained in 1937 in four counties of the Piedmont indicates the range in assessments and taxes per acre.[2] Woodland was assessed at $10.83 in Rutherford County and $20.88 in Durham County, while timber land varied from $7.73 in Rutherford County to $26.54 in Iredell County. The average tax per acre ranged from 4.7 cents on wasteland to 35.6 cents on timber land. The Exemption Law passed in 1939 is of particular importance to farmers who wish to plant trees on abandoned farm land. It instructs tax assessors to make no increase in the tax valuation of reforested land until 10 years after such planting.

Land Ownership and Use

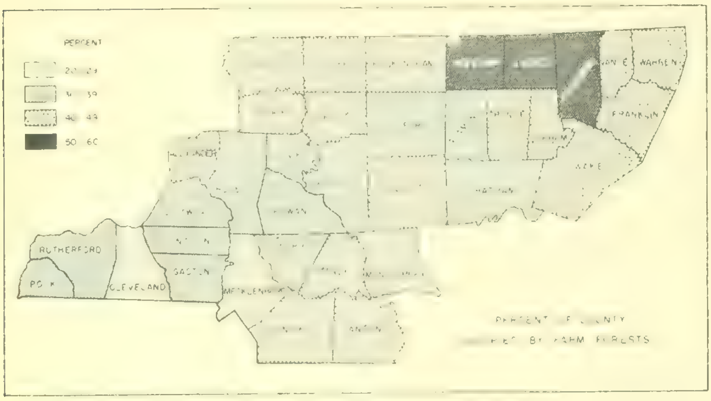

FIGURE 5

Eighty-five percent of the forest land in the unit is in farm ownership. Industrial ownership by forest-products industries is very limited, probably totaling less than 50,000 acres in tracts generally smaller than 1,000 acres. Federal ownership is limited to 23,000 acres in Davidson, Montgomery, and Randolph Counties that make up part of the Uharie Forest Purchase Unit. The State owns 7,300 acres in the Hanging Rock and Morrow Mountain State Parks, located in Stokes and Stanley Counties, respectively. The remaining forest area, about 700,000 acres, belongs to power companies, local townspeople, and other private owners. Planned sustained yield management is practiced on very little of the forest land, probably less than 10 percent.

The use of land in the Piedmont now depends primarily upon the customs, attitudes, and practices of the 120,000 farm operators who manage 80 percent of the land. These operators are influenced, however, by many factors over which they have no control and the end result is a compromise between what the farmers would like to do and what they are forced to do by governmental action, loss of markets, changes in consumer demands, and other economic conditions. Such far-off developments as England's recent trade agreement with Turkey will probably cause a reduction in the tobacco acreage in this unit and may cause some land abandonment.

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[2] Nelson, R. W. Taxation of forest property in North Carolina, Forest Taxation Inquiry, U. S. Forest Service.

According to the Survey, approximately the same amount of land was used for agriculture as for forest in 1937 (table 1). This proportion may change in the future in favor of forests because the constant increase in yields of agricultural crops per acre reduces acreage requirements. On the other hand urban population growth is extremely rapid in this unit and greater emphasis upon agricultural production for local consumption may cause an increase in agricultural land use. At the same time a growing population creates an increased demand for fuelwood, building material, containers, furniture, and other wood products which the present forest cannot satisfy. Gradual adjustments in land use will undoubtedly occur, but at best they will be haphazard until a coordinated long-time land-use plan is prepared for each county of the unit.

Table 1. - Total land area classified according to major use, 1937

Land use*	Area	Proportion of total area
	Acres	Percent
Forest:		
Productive**	4,968,100	47.0
Nonproductive	4,100	Negl.
Total forest	4,972,200	47.0
Nonforest:		
Agriculture:		
Old cropland	4,563,500	43.1
New cropland	127,900	1.2
Pasture	289,900	2.8
Total agriculture	4,981,300	47.1
Abandoned cropland	121,300	1.1
Other nonforest	505,000	4.8
Total nonforest	5,607,600	53.0
Total area	10,579,800	100.0

*Refer to glossary for description of terms.

**Productive forest area used throughout the report.

DESCRIPTION OF THE FOREST RESOURCE

Historical records and studies by ecologists indicate that the original forest of the Piedmont was a mixture of hardwoods, chiefly oak and hickory, with a small amount of pine. Ashe[3] believed the best-quality and purest stands of hardwood were between the mountains and a line drawn through the present cities of Charlotte, Salisbury, and Greensboro. It seems probable that shortleaf pine was developed best in the northeastern portion of the Piedmont and loblolly pine on the level lands along the southeastern border.

A rather rapid cycle of land clearing and land abandonment continued until the latter part of the past century, since then it has proceeded at a slower pace. The abandoned fields, with their exposed mineral soil, have provided an excellent seedbed for the light, wind-borne seeds of the occasional pine trees in adjacent timber stands. A high proportion of the total area of the Piedmont has been subjected to this seeding process and the result was to change the characteristic type from mixed hardwoods to old-field pine. How long the pine types will continue to be dominant under the more stable land-use practices of today is problematical, but at the time of the Survey in 1937 they occupied three-fourths of the 5 million acres of forest land.

Species

Shortleaf pine is the most abundant tree in respect to both number of stems and board-foot volume. It is distributed throughout the Piedmont on the better-drained soils but is most prevalent southeast of Statesville, Winston-Salem, and Greensboro (fig. 7). Loblolly pine ranks next in abundance and occurs chiefly in Warren, Franklin, Wake, Chatham, and Anson Counties. Virginia pine, often called scrub pine because of its brushy appearance, occupies a broad belt along the northern boundary from Caswell County west to the mountains and southwest along the mountains to South Carolina.

Yellowpoplar is found throughout the unit although it is rather infrequent in Stanley, Union, and Anson Counties. Sweetgum is most prevalent east of Caswell, Alamance, and Chatham Counties in conjunction with the loblolly pine-hardwoods type (fig. 7) but it is common everywhere. Merchantable trees of the red and white oaks, hickories, and eastern redcedar are widely scattered and only in rare instances do any of these species form extensive merchantable stands. The larger trees of the several species are most frequent in the areas outlined in figure 6, but even in these localities they are of scattered occurrence.

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[3] Pinchot, G. and W. W. Ashe. Timber trees and forests of North Carolina. Bul. 6., North Carolina Geological Survey, 1897.

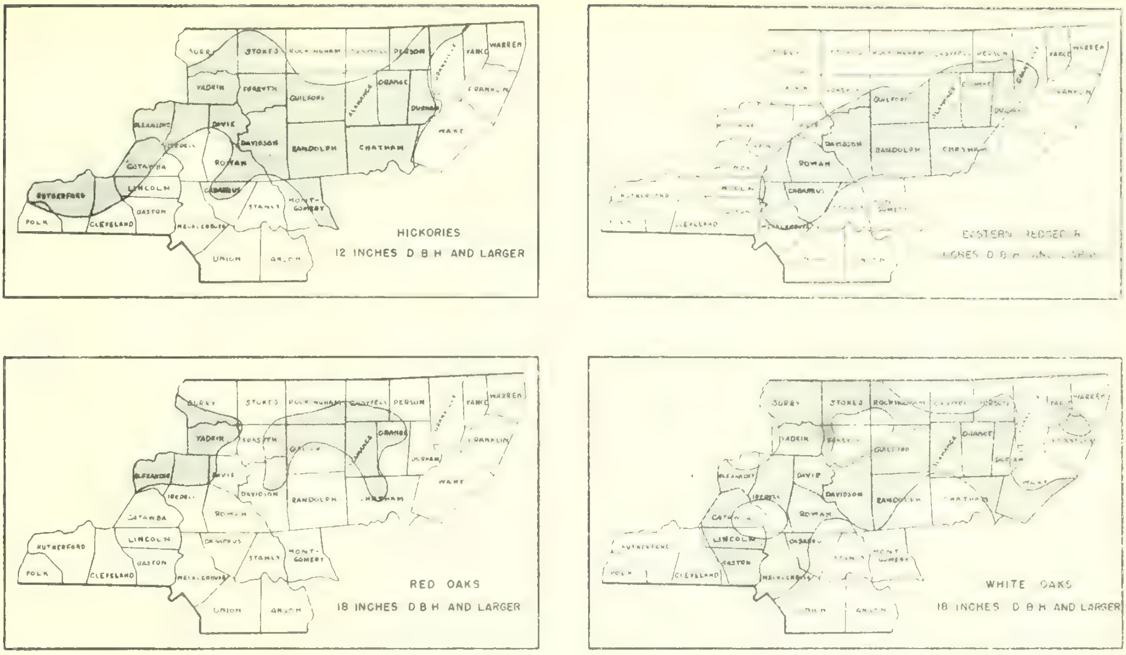
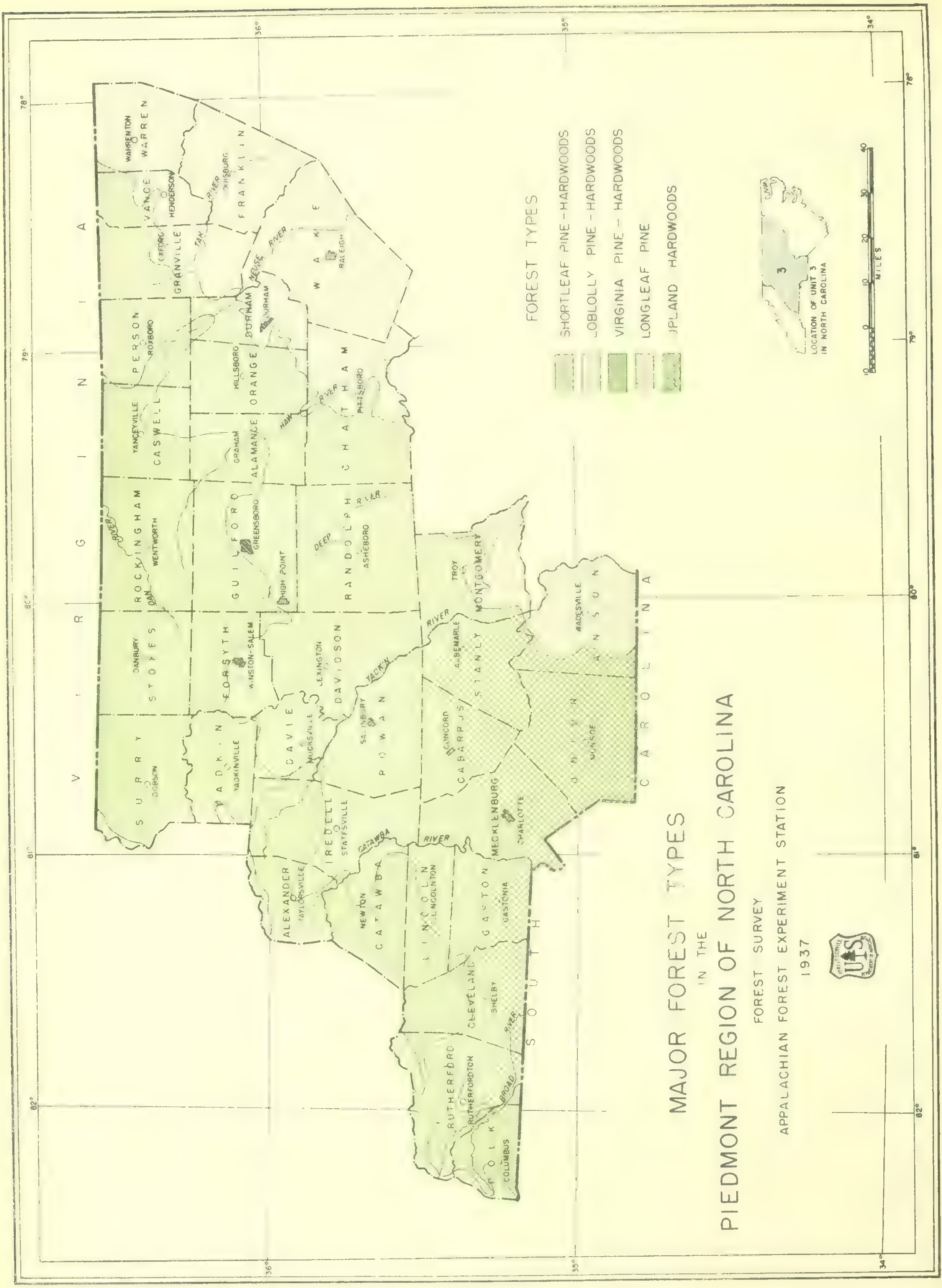


FIGURE 6.- LOCATION OF THE PRINCIPAL SUPPLY OF LARGE OAKS, HICKORIES, AND EASTERN REDCEDAR

Forest Types

The forests of the Piedmont were classified by the Survey into forest cover types on the basis of stand composition and the proportion of commercially important dominant trees. The type areas given in the forthcoming tables are based upon the number of plots that were recorded in the various forest types and are a reasonably accurate measure of the extent of the various types in the unit. The forest type map, however, is merely a delineation of the broad areas in which given forest types predominate and it does not show accurate type areas, included agricultural land, or local variations in the predominant forest cover (fig. 7)

The loblolly pine-hardwood type, which occupies a belt of land about 30 miles wide along the eastern border of the Piedmont, is contiguous with, and similar to, the loblolly pine-hardwoods type of the Coastal Plain. It contains about 639,000 acres and makes up about 13 percent of the total Piedmont forest. Practically pure loblolly pine stands occur on three-fifths of the type area, while a variety of hardwood species are mixed with the loblolly pine on the remainder. Sweetgum and yellowpoplar grow with the pine along small streams where the soil is more fertile and moisture more abundant. Black, southern red, and post oaks are more often associated with it on the drier rolling hills. Shortleaf pine also forms an appreciable part of the type volume, particularly along the western limit of the type. As the sandy-clay subsoils of the eastern Piedmont give way to the red clay subsoils of the central Piedmont, shortleaf pine becomes the dominant species.


MAJOR FOREST TYPES IN THE PIEDMONT REGION OF NORTH CAROLINA

FOREST SURVEY

APPALACHIAN FOREST EXPERIMENT STATION

1937

Figure 7

The extent of the shortleaf pine-hardwoods type is shown in figure 7. It is the major type of the unit, occupying 2.3 million acres, 47 percent of the forest land. Stands of shortleaf pine, generally of old-field origin, occupy about half of the type area, while on the other half the stands are composed of shortleaf pine, white, black, southern red, and scarlet oaks, yellowpoplar, hickories, and a variety of other hardwood species. Eastern redcedar often occurs as a thin understory in these pine-mixed hardwood stands, but its total volume is relatively insignificant. Loblolly pine merges with shortleaf along the border of the two type areas and is sometimes found in the stream valleys that cross the shortleaf pine belt. Virginia pine also intrudes into the shortleaf pine-hardwoods type along its western border and as the compact red clay loams of the central Piedmont change to sandy loams in the northern Piedmont and foothills region it largely replaces shortleaf pine in the forest stand.

The forests classified as Virginia pine-hardwoods occupy about 600,000 acres, 12 percent of the wooded land in the Piedmont. They extend from the typical rolling country of the central Piedmont northward and westward to the base of the Blue Ridge. Virginia pine, with only a small admixture of other species, occupies three-fifths of the forested land. Most of this pure pine is of old-field origin. Forest-grown stands typically include a mixture of hardwoods, such as white, post, black, scarlet and chestnut oaks, yellowpoplar, hickories, sweetgum, sourwood, and dogwood. Shortleaf pine occurs with Virginia pine both in old-field and forest grown stands.

The upland hardwoods type includes local bodies of hardwood intermingled with the pine types. Often of small size, these tracts of hardwood are distributed throughout the unit and in the aggregate occupy 24 percent of the forest land. Although predominantly an oak-hickory type the species composition varies widely in different localities, being influenced by soil, slope, elevation, and moisture conditions. White oak (Quercus alba) is most abundant, but post, southern red, northern red, scarlet, black, and chestnut oaks, hickories, yellowpoplar, sweetgum, dogwood, maple, ash and many other species occur on the sites favorable to their development.

The strips of lowlands along most of the rivers are not wide although a few broad flats occur near some of the larger streams in the eastern Piedmont. The bottom-land hardwoods type is, therefore, restricted to narrow valleys along the larger rivers, to the occasional broad flats, and to the margins of the smaller streams. In all, this type occupies only 4 percent of the forest area. The soils along the larger rivers are generally a silty alluvium conducive to the growth of sweetgum, yellowpoplar, swamp chestnut oak, water and willow oaks, hickories, sycamore, elm, and blackgum. On the flats, willow and water oaks predominate. The sandy loams bordering the small streams support beech, river birch, red maple, yellowpoplar, sweetgum, willow, and a scattering of red and white oaks. Loblolly pine is frequently seen along both large and small streams in the eastern part of the Piedmont and shortleaf pine occasionally extends into the smaller bottoms of the upper Piedmont.

The species composition of the five forest types is expressed by means of percentages in table 2. The cubic-foot volumes upon which the proportions are based contain both wood and bark of all sound trees 5.0 inches d.b.h. and larger. The full stems to a minimum 4-inch top of all pines and under-sawlog-size hardwoods are included as well as the sawlog portion of merchantable hardwoods. Measured in this way, the leading species in the unit are shortleaf pine, loblolly pine, white oaks, Virginia pine, and the red oaks.

Table 2. - Species composition of the forest types

Species	Shortleaf pine-hardwoods	Loblolly pine-hardwoods	Virginia pine-hardwoods	Upland hardwoods	Bottom-land hardwoods	All types
			Percent of cubic volume (o.b.)			
Shortleaf pine	70.2	10.2	15.8	6.6	2.0	40.8
Loblolly pine	3.3	70.3	0.3	0.8	3.4	12.5
Virginia pine	3.3	0.2	61.5	0.9	0.1	7.7
Eastern white pine	0.1	--	0.4	0.2	--	0.1
Eastern redcedar	0.7	0.2	0.4	0.4	0.1	0.5
Sweetgum	2.4	5.6	1.3	4.1	21.7	4.0
Yellowpoplar	3.7	3.3	5.5	8.6	14.0	5.3
Red oaks	4.5	2.0	3.9	20.3	5.0	7.1
White oaks	6.0	3.0	5.2	31.2	5.9	10.2
Hickories	2.4	1.0	2.1	14.0	3.0	4.4
Dogwood*	0.5	0.3	0.5	1.1	1.1	0.6
Scrub hardwoods**	0.7	0.4	0.5	2.0	0.8	0.9
Other hardwoods	2.2	3.5	2.6	9.8	42.9	5.9
Total	100.0	100.0	100.0	100.0	100.0	100.0

*Includes persimmon, black locust, holly, and mulberry.
**Includes scrub oaks, sassafras, and sourwood.

Forest Conditions

The forest stands were also grouped into forest condition classes on the basis of tree-diameter, age, volume-per-acre, and cutting history. Old-growth stands occupied 9 percent of the forest land, second-growth sawlog-size stands 43 percent, and under-sawlog-size stands 48 percent.

It would be erroneous to assume that the 464,000 acres of old-growth timber are all original virgin forest (table 3). The forest stands classified as old growth may, in the case of pine, contain trees only 70 years old, but equal in quality to virgin growth. In the upland hardwoods, where half of the old growth occurs, the trees are frequently only the low-quality species left from the original stand, for in both the hardwoods and pine three-fourths of the old growth has been culled for selected species or sizes. Most of the pine old growth is in the shortleaf pine hardwood type, where it typically occurs as small scattered patches of a few acres each. These small areas are nowhere abundant but are most frequent in the western part of the Piedmont along the base of the Blue Ridge. The old-growth hardwoods are equally irregular in local occurrence, but are most common east of Caswell, Alamance, and Randolph Counties.

Table 3. - Forest area classified according to forest condition and forest type, 1937

Forest condition	Shortleaf pine-hardwoods	Loblolly pine-hardwoods	Virginia pine-hardwoods	Upland hardwoods	Bottom-land hardwoods	Total all types	Proportion of total
	- - - - - -	- - - - - -	- - - -	Acres	- - - -	- - - - - -	Percent
Sawlog size:							
Old growth:							
Uncut	42,300	3,300	2,500	44,000	15,000	107,100	2.1
Partly cut	107,200	30,700	7,500	181,100	30,700	357,200	7.2
Total	149,500	34,000	10,000	225,100	45,700	464,300	9.3
Second growth:							
Uncut	662,900	149,500	181,900	189,400	59,000	1,242,700	25.0
Partly cut	450,200	171,100	70,600	167,800	27,400	887,100	17.9
Total	1,113,100	320,600	252,500	357,200	86,400	2,129,800	42.9
Total sawlog size	1,262,600	354,600	262,500	582,300	132,100	2,594,100	52.2
Under sawlog size:							
Second growth	966,900	248,400	291,500	597,200	76,400	2,180,400	43.9
Reproduction*	84,700	35,700	51,500	17,500	4,200	193,600	3.9
Total	1,051,600	284,100	343,000	614,700	80,600	2,374,000	47.8
Total all conditions	2,314,200	638,700	605,500	1,197,000	212,700	4,968,100	100.0
Percent of total	46.6	12.8	12.2	24.1	4.3	100.0	

*Includes 4,200 acres of clear-cut condition.

Second growth saw-timber stands occupy 43 percent of the forest land, or 2.1 million acres. About half of this merchantable second growth is in the shortleaf pine-hardwoods type, 17 percent is in upland hardwoods, 15 percent is in loblolly pine-hardwoods, 12 percent is in Virginia pine-hardwoods, and only 4 percent is in bottomland hardwoods. Light cutting has removed part of the saw-timber volume on 42 percent of the total area in this condition and in the loblolly pine-hardwoods type, where the best saw timber occurs, 53 percent of the area has been partly cut. Sawlog-size stands prevail throughout the Piedmont, but most abundantly east of the Yadkin River.

The forest area stocked with under-sawlog-size trees over one inch in diameter is equal to the area of sawlog-size second growth. Even in these young stands partial cutting, caused undoubtedly by the intense demand for fuelwood, has occurred on 15 percent of the area. Pine types occupy 70 percent of the area as compared to 80 percent in second-growth sawlog-size stands. Blocks of young timber are inter-mixed with saw-timber stands throughout the Piedmont and do not appear concentrated in any one locality.

Scarcely any of the forest land is in the clear-cut condition and less than 4 percent is classified as reproduction. These reproduction areas have sufficient seedlings and sprouts of commercial species to develop into commercial stands, indicating that natural reforestation is taking place on most cut-over land. In many cases, however, this natural replacement is extremely slow, the trees are often poorly spaced, and desirable species do not always occupy the land.

Site Quality

Site quality is a measure of the productivity of forest land. It is influenced by many factors, but chiefly by soil and climate. Although expressed in several ways, an index commonly used is that based upon the height of average dominant trees at 50 years of age. This method of estimating site quality was used in the Piedmont where the land in each pine type was classified by index determination of the pine species controlling the type classification.

Apparently the abandoned fields of the central Piedmont are rather poor sites for pine, as well as for cotton, because 84 percent of the shortleaf pine-hardwoods type area has a site index of not more than 60 feet (table 4). On good shortleaf sites, such as those of southeast Alabama, only 50 percent of the type area has such a poor site index. The Virginia pine-hardwoods type area in the western Piedmont is also poor in site quality although the inferior showing may be partly due to the growth characteristics of Virginia pine. The rolling hills bordering the Coastal Plain are excellent sites for loblolly pine, as 90 percent of the loblolly pine-hardwoods type has a site index of 70 feet or more. By comparison, equally good sites occur on only 80 percent of the loblolly pine area in the Coastal Plain.

Table 4. - Pine-hardwoods area classified according to site

Index species for corresponding pine type areas	Site index in feet		
	[illegible]	70 and 80	60 and less
	- - - - - - - - - -	Percent	- - - - - - - - - -
Shortleaf pine	Negl.	16	84
Loblolly pine	5	85	10
Virginia pine	--	8	92

The importance of site quality should not be minimized for it is the basic factor controlling yields of wood. Usually it can be improved by intensive fire control and silvicultural practices but it is a long, slow process. Profitable forestry requires a thorough knowledge of the yield potential of the forest land under management, because it is frequently possible to produce more wood at less cost on a small area with a good site index, than on a much larger area with a poor site index. For instance, about three-fourths as much timber can be produced on the good sites occupying 30 percent of the Piedmont pine area as on all the rest of the pine land.

Age

Young, even-aged stands of old-field origin are characteristic of the pine types in the Piedmont. Stands in the various condition classes do not vary greatly in age by forest type, most of the under-sawlog-size pine timber is below 30 years of age and most of the sawlog-size second-growth pine is 30 to 60 years old. The minimum age of pine timber of old-growth quality is 70 years.

The hardwood stands are older and less even-aged than the pine stands. Many of the older stands have an understory of younger age-classes present but where cattle grazing is intensive younger trees are scarce or absent. Most of the hardwoods are sawlog size when 50 to 60 years of age. They require longer to reach merchantable size because they grow slower than pine and the minimum diameter limit for hardwood saw timber is higher. Practically all of the old-growth hardwoods are more than 100 years old.

A proper area distribution of age-classes is essential for continuous forest production. Well-managed forests have at all times the proportion of young, middle-aged, and old stands that will insure a steady supply of harvestable timber. The proportionate area in each age-class will vary with the length of rotation and method of management. Rotations are influenced by species, site, product, and financial considerations and management methods may vary from selection cutting to clear-cutting and planting.

The Piedmont forest is a composite of many thousand small forest areas, each managed or abused in a slightly different way. A correct area distribution for the forest as a whole can only be accidental under such circumstances, but reference to figure 8 shows the present proportions are not altogether unfavorable for continuous production of saw timber. A rather large proportionate area is stocked with trees below 40 years of age in the Virginia pine-hardwoods and loblolly pine-hardwoods types but the shortleaf pine-hardwoods type, which occupies nearly half the forest area, is reasonably satisfactory in age-class distribution. There is a noticeable lack of pine-hardwood stands more than 80 years old but this is not serious because excellent pine saw timber can be grown on an 80-year rotation. The upland hardwoods have a large area in the oldest age-class but most of these stands have been severely culled.

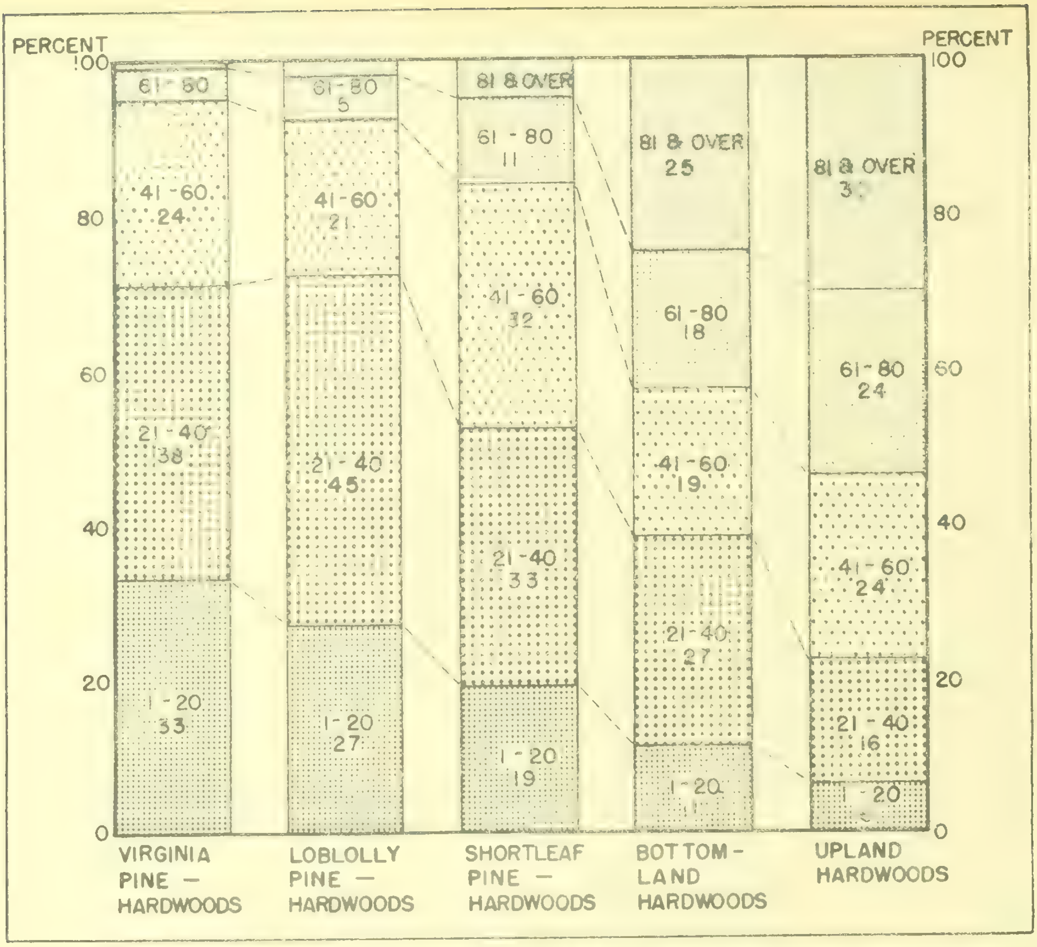


FIGURE 8.- PERCENT OF FOREST TYPE AREAS IN 20-YEAR AGE-CLASSES, 1937

Stocking

In general, the forests of the Piedmont are understocked. This means a large proportion of the forest land can support more trees per acre and by so doing can produce greater annual yields of better-quality wood. How much greater these yields can be depends upon the degree of present understocking and the application of correct methods of forest management. At the outset it should be realized that some stands are too heavily stocked and can be improved by thinning, while the vast majority are too thinly stocked and should be built up for greater productivity of wood in both quantity and quality.

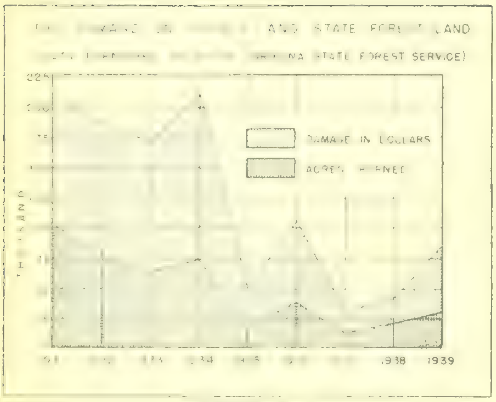
The stocking of the shortleaf pine type serves to illustrate the general situation throughout the unit. This type occupies almost one-fourth of the forest land, is dominantly pure shortleaf pine, and commonly occurs in even-aged stands. It should not be confused with the combined shortleaf pine and shortleaf pine-hardwoods type which occupies 47 percent of the forest area.

To arrive at an estimate of stocking in the shortleaf pine type the average cordwood volume per acre of uncut stands in each age-class is compared with the average volumes, weighted by site, of the best-stocked 10 percent of these same stands (table 5). The volumes-per-acre occurring in the best 10 percent of the stands closely approximate full stocking. By comparison, the average stand in the 11 to 20-year age-class is only 24 percent stocked while the oldest average stands are 69 percent stocked. The average stands obviously approach full stocking as they grow older. The rate of approach is rapid in the younger stands, gradually tapering off as they reach maturity.

Table 5. - Average volumes per acre, by age-classes, in the uncut conditions of the shortleaf pine type

Age-class	Based on all stands	Based on best 10 percent of stands	Relation of all stands to best 10 percent
Years	Cords	Cords	Percent
11 - 20	2.0	8.5	24
21 - 30	9.0	21.0	43
31 - 40	20.0	35.5	56
41 - 50	25.5	42.5	60
51 - 60	28.5	46.5	61
61 - 70	31.0	48.5	64
71 - 80	33.0	49.0	67
80 and over	34.0	49.0	69
Weighted average of all age-classes	15.8	28.9	55

Forest Fires



Forest fires are not so serious a problem in the Piedmont as in the Coastal Plain and Mountain regions of North Carolina. Although numerous ownerships tend to increase the fire hazard in some respects they also serve to break up the forest land into small scattered blocks in which fires can be localized. Furthermore most of the woodland is on farms where it provides the farm operators with fuelwood, fenceposts, building material, and commercial forest products. The intensive demand for these products provides considerable incentive for protecting timber stands from fire. In 1937-38 only 10 of the 35 counties in the unit were cooperating financially with the fire control division of the North Carolina State Forest Service. The beneficial effect of the State's fire control program extends throughout the unit, however, and since 1931 the annual loss from fire, both in acres and dollars, has been reduced by more than one-half in the entire unit (fig. 9).

At the time of the survey in 1937 there was no evidence of past forest fires on 65 percent of the forest area (table 6). By comparison, the effect of forest fires was noticeable on more than 80 percent of the forest land in the Southern Coastal Plain of North Carolina. Signs of previous fires, so light they caused no apparent damage, were evident on 21 percent of the area and light to medium fire damage was recorded on 14 percent. The upland hardwoods were burned more severely than any other type. Fire has been present on 44 percent of the type area, and light to medium damage has occurred on nearly half of the burned acreage. A higher proportionate area of the loblolly pine-hardwoods type is burned over than of the other two pine types. Less than one-fourth of the Virginia pine-hardwoods type has been subjected to fire and only three percent of it has suffered medium to heavy damage. Least affected by fire is the bottom-land hardwoods type. Only 9 percent of its area has been damaged by fire.

Table 6. - Degree of fire damage by forest type

Degree of damage	Shortleaf pine-hardwoods	Loblolly pine-hardwoods	Virginia pine-hardwoods	Upland hardwoods	Bottom-land hardwoods	All types
	- - - - -	- - - Percent	of type area	- - -	- - -	- - -
No fire	56	62	76	56	82	65
Present - no damage	23	19	14	24	9	21
Damage light	9	14	7	16	5	11
Damage medium	2	5	2	4	3	3
Damage heavy	Negl.	Negl.	1	Negl.	1	Negl.
Total	100.0	100.0	100.0	100.0	100.0	100.0

VOLUME OF THE FOREST RESOURCE

The 1937 inventory of the timber resource included the sound volume of all living trees 5.0 inches d.b.h. or larger. Dead trees were tallied but their volume is shown only as mortality drain in the tables showing comparisons of growth and drain. Estimates of the volume of sound wood are given in board feet, cords, and cubic feet. Volumes expressed in board feet include only the sawlog portion of saw-timber trees (pines and red cedar 9.0 inches d.b.h. and larger, hardwoods 13.0 inches d.b.h. and larger). Cordwood volumes (wood and bark) include the sawlog portion of all saw-timber trees, the cordwood material in the upper stems of pine and the upper stems and limbs of hardwood saw-timber trees, the sound stems of both pine and hardwood under-sawlog-size trees, and the sound volume in cull trees. Bark is omitted from cubic-foot volumes, otherwise the basis of estimate is the same as for cordwood.

The various species of hardwoods have been grouped together in rather broad classes in the following presentation of volume data. The red oaks include southern red oak, northern red oak, and swamp red oak; species which generally produce good quality material. The so-called inferior red oaks include black, scarlet, pin, water, and willow oaks. These species are not always of poor quality but in general produce a smaller proportion of the better grades of lumber. The white oaks are swamp chestnut and forked-leaf white oak. Usually these species are of good quality and are preferred for tight cooperage, furniture stock, and high-grade flooring. Where forked-leaf white oak occurs on the drier uplands and poorly-drained flats it is, however, often defective and of bad form. Post and chestnut oaks comprise the inferior white oak group. They frequent poor sites and normally do not compare in quality with swamp chestnut and forked-leaf white oaks. The hickory group consists chiefly of southern shagbark, pignut, and mockernut hickories. They are used, without distinction between species, for special products such as handles and picker sticks. The remaining hardwood species are placed in a single group -- other hardwoods. On a board-foot volume basis blackgum is most abundant, followed in descending order by maple, willow, elm, ash, beech, and birch. Of these, probably the greatest demand is for maple and ash.

Board-foot Volume

An estimate of the volume is computed with three log rules - International ¼-inch, Scribner, and Doyle (table 7). In each case the volumes are net log scale, deduction having been made for material that would be left in the woods because of rot, crook, limbiness, and other defects and for loss at the mill caused by sweep and interior defects. The International ¼-inch rule, used exclusively for subsequent board-foot volume tabluations and statements in this report, approximates the amount of green lumber that can be sawed from the saw-timber trees. The Scribner rule gives a less satisfactory measure because it is based upon a diagram of the small end of the log and does not allow for taper. The Doyle rule is based on a formula and although widely used it is the least accurate. The timber in this unit will saw out about 70 percent more lumber than the Doyle rule indicates. This proportion is influenced by the distribution of tree diameters, however, and it will vary from stand to stand. More consistent results can be obtained with the International rule or with lumber tally measurement.

Table 7. - Net volume by the International $\frac{1}{4}$-inch, Scribner, and Doyle rules classified according to species-group, 1937

Species-group	International*	Scribner	Doyle
	- - - - - - - - Thousand board feet	- - - - - - - -	- - - - - - - -
Pines:			
Shortleaf	5,003,300	4,134,000	2,567,800
Loblolly	1,704,000	1,444,300	970,100
Virginia	910,400	750,900	439,800
Other softwoods	55,900	46,300	27,300
Total softwoods	7,673,600	6,375,500	4,005,000
Hardwoods:			
Sweetgum	371,800	335,500	260,500
Yellowpoplar	585,500	530,200	415,800
Red oaks	334,900	305,100	244,900
Inferior red oaks	429,800	390,000	306,400
White oaks	787,900	718,700	580,600
Inferior white oaks	178,200	160,400	124,300
Hickory	315,800	288,100	216,700
Other hardwoods	406,100	363,300	281,700
Total hardwoods	3,410,000	3,091,300	2,430,900
Total all species	11,083,600	9,466,800	6,435,900

*The scale by this rule approximates green lumber tally.

The 7.7 billion board feet of pine saw timber in this unit (table 8) is 28 percent of the pine volume in the State. Two-thirds of it is shortleaf pine, one-fifth is loblolly pine, and about one-tenth is Virginia pine. Redcedar makes up two-thirds of the "other softwood" volume, and the remainder is white pine and hemlock.

Old-growth stands contain 18 percent of the pine volume and under-sawlog-size stands only 5 percent. Second-growth stands of sawlog-size are the important source of pine saw timber, containing over three-fourths of the total volume. About 4 billion board feet is in stands in which little, if any, cutting has taken place. These uncut pine stands occupy 20 percent of the total forest area and average 4,100 board feet of pine per acre. The second growth partly cut pine stands contain 1.7 billion board feet of pine, distributed over 14 percent of the forest area. Because part of their volume has been removed they average only 2,400 board feet of pine per acre.

The 3.4 billion board feet of hardwood saw timber in the Piedmont (table 8) is 24 percent of the hardwood volume in the State. In relation to the forest area involved there is less hardwood than in the Coastal Plain or Mountain regions. The volume is rather uniformly distributed among the species; forked-leaf white oak is most abundant, followed closely by yellowpoplar. The better-quality red and white oaks make up about one-third of the total volume. Most of the hardwood species are being used by the furniture industry but part of the volume is unsuitable for such use because of its poor quality.

Table 8. - Net volume by the International ¼-inch rule classified according to species-group and forest condition, 1937

Species-group	Sawlog size				Under sawlog size*	Total	Proportion of total
	Old growth		Second growth				
	Uncut	Partly cut	Uncut	Partly cut			
	- - - - - - - - -	Thousand board feet	- - - - - - - - -				Percent
Pines:							
Shortleaf	455,900	554,800	2,724,400	1,049,800	218,400	5,003,300	45.1
Loblolly	67,400	256,700	812,000	501,500	66,400	1,704,000	15.4
Virginia	13,700	20,400	640,000	180,100	56,200	910,400	8.2
Other sftwds.	4,800	3,100	21,600	7,600	18,800	55,900	0.5
Total	541,800	835,000	4,198,000	1,739,000	359,800	7,673,600	69.2
Hardwoods:							
Sweetgum	61,900	77,600	105,200	107,600	19,500	371,800	3.4
Yellowpoplar	54,300	104,100	280,700	131,800	14,600	585,500	5.3
Red oaks	44,000	110,800	95,000	59,800	25,300	334,900	3.0
Inferior r.o.	31,000	123,900	147,300	91,300	36,300	429,800	3.9
White oaks	118,400	313,400	202,800	106,800	46,500	787,900	7.1
Inferior w.o.	17,100	63,800	44,400	30,000	22,900	178,200	1.6
Hickories	46,600	88,800	86,100	57,900	36,400	315,800	2.8
Other hdwds.	59,700	97,200	140,800	79,700	28,700	406,100	3.7
Total	433,000	979,600	1,102,300	664,900	230,200	3,410,000	30.8
Total all species	974,800	1,814,600	5,300,300	2,403,900	590,000	11,083,600	100.0
Percent of total	8.8	16.4	47.8	21.7	5.3	100.0	

*Includes reproduction condition.

About 40 percent of the hardwood volume is in old-growth stands. All too often the upland old growth consists of poor-quality individuals, for nearly three-fourths of the old-growth volume is in stands that have been culled of the best trees. Species such as yellowpoplar, sweetgum, and the better-quality red and white oaks make up three-fifths of the volume; the inferior oaks, hickories, and other hardwoods comprise the remainder.

Sawlog-size second-growth stands contain 52 percent of the hardwood volume. Yellowpoplar and the white oaks are particularly abundant species in the uncut stands but where partial cutting has occurred they have been utilized more intensively than the other hardwood species. They constitute 44 percent of the uncut stand volume and only 36 percent of the partly-cut stand volume. This concentration of the cut in the better species causes the inferior red and white oaks to make up an increased proportion of the stand.

Seven percent of the hardwood board-foot volume is in under-sawlog-size stands. The saw-timber trees in these stands usually occur as scattered individuals and seldom provide enough concentrated volume for logging operations. Younger trees are constantly reaching sawlog size, however, and every year a small proportion of the under-sawlog-size stands acquires enough board-foot volume to be classified as sawlog size. A large part of the present saw-timber volume is concentrated in the white oaks, inferior red oaks, and hickories.

Volume by diameter-class: A high proportion of the saw timber in this unit is in small trees. Nearly 60 percent of the pine board-foot volume is in trees less than 13.0 inches d.b.h. and more than 60 percent of the hardwood volume is in trees less than 19.0 inches d.b.h. (fig. 10). Small trees are relatively more expensive to log and transport to the mill than large ones, and sawmills cannot produce as much lumber per day from small logs. Costs per thousand board feet are therefore higher and lumber values are lower because small trees usually yield lower grades and narrower widths. Although these small trees are not so profitable to manufacture on a per thousand foot basis they furnish the log sizes most usable in the small sawmills of the region and yield lumber grades for which there is the greatest demand. In practice, the effect of tree sizes is not always reflected in sawmill costs and returns because logging and hauling is often contracted out at a flat rate on a piece-work basis and the rough lumber is frequently sold without regard to grade.

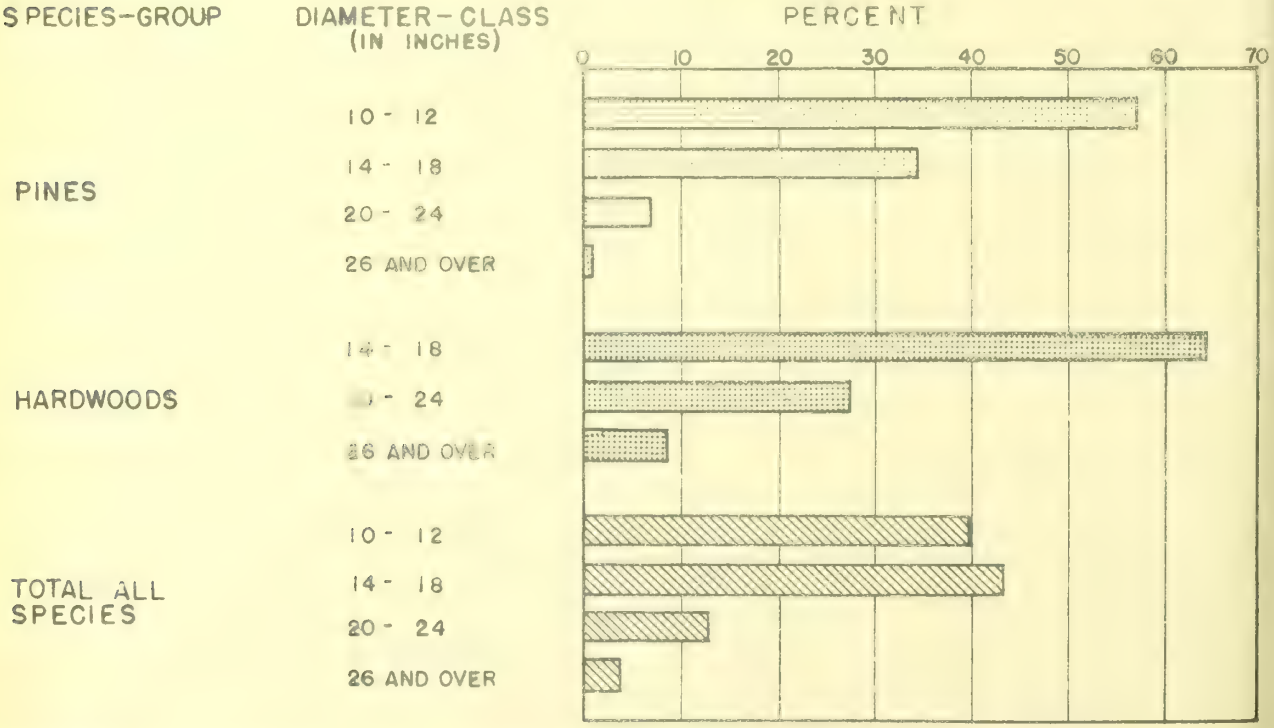


FIGURE 10 - DIAMETER DISTRIBUTION OF BOARD-FOOT VOLUME (INTERNATIONAL 1/4-IN. RULE)

Distribution by area and volume: It is probably more important to the sawmill operators of the Piedmont to have a heavy stand per acre, even in small trees, than it is to have a high proportion of the volume in large trees. Nearly all of the sawmills are small portable outfits. In most cases the mill is moved whenever the log haul must exceed one-half mile. Frequency of movement and moving expense depends upon the volume of merchantable timber per acre in the sawlog-size stands. Volume per acre also has a strong influence upon the amount that can be spent for logging roads and other improvements and in most cases is the factor controlling economic availability.

Volumes of 2,000 board feet per acre are considered a fair logging and milling chance in the Coastal Plain and Piedmont regions of North Carolina. In the sawlog-size stands of the pine and pine-hardwoods types of this unit 90 percent of the volume is in stands of 2,000 board feet or over, which occupy 70 percent of the type area (fig. 11). Nearly one-fourth of all the pine volume is on 7 percent of the pine area in stands per acre of 10,000 or more board feet. Slightly over half of the pine land supporting sawlog-size stands is stocked with 1,000 to 4,000 board feet per acre.

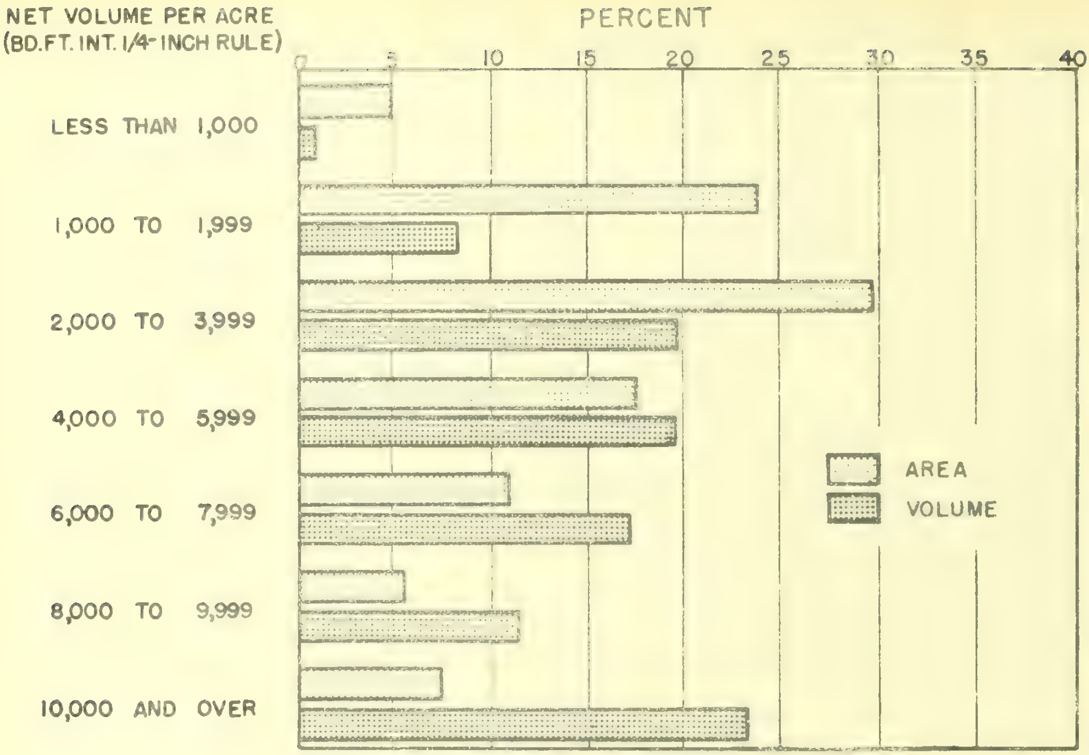
Eighty-four percent of the volume in the sawlog-size hardwood stands is in concentrations of 2,000 or more feet per acre, and these stands occupy 60 percent of the hardwood saw-timber area. Stands of 10,000 or more board feet per acre are found on only two percent of the area and contain only 10 percent of the hardwood volume. About two-thirds of the hardwood area is stocked with stands containing 1,000 to 4,000 board feet per acre.

Taking the sawlog-size stand as a whole, 89 percent of the board-foot volume is in stands of 2,000 or more feet per acre and these stands occupy 68 percent of the saw-timber acreage.

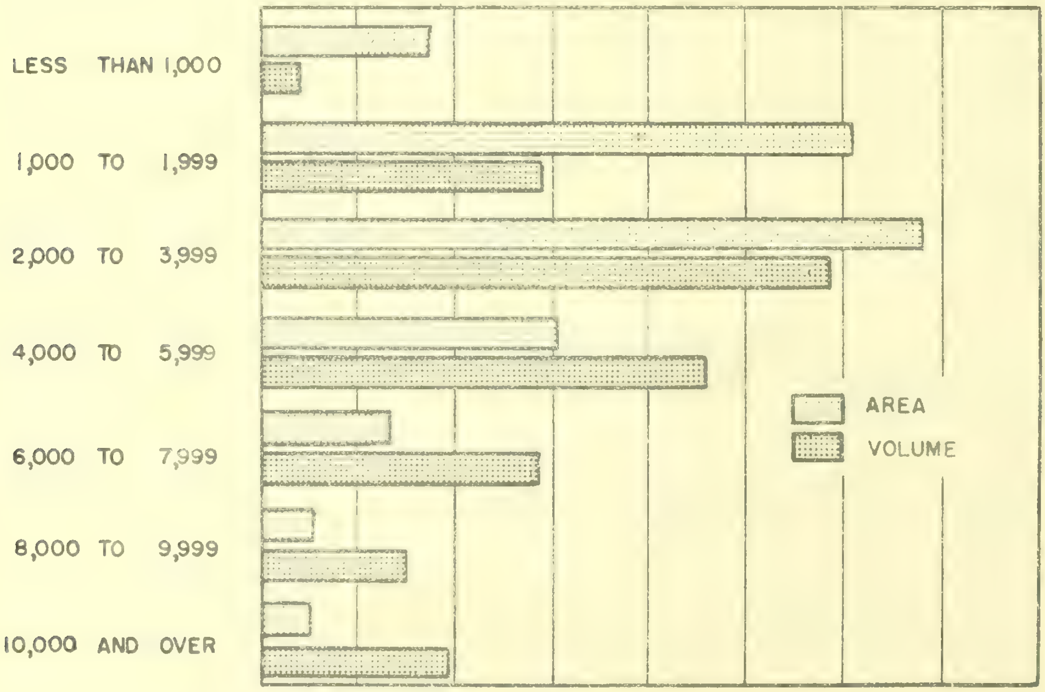
Volumes per acre: The total board-foot volume has been converted to a per-acre basis, by forest types and conditions (table 9). The values shown are seldom applicable to a few acres of timber but for a holding of several thousand acres they would indicate the average per-acre volume within a given type and condition with a fair degree of accuracy.

The per-acre volumes of the shortleaf pine-hardwoods type are especially interesting for this type occupies 47 percent of the forest area. The average volume of the old-growth uncut stand is impressive but relatively unimportant because of the small acreage involved. The second-growth uncut condition will supply a large part of the immediate saw-timber needs, and the volume of 4,800 board feet per acre is enough to provide for a satisfactory cut on most areas without removing the entire board-foot growing stock. The under-sawlog-size stands, occupying one million acres, have a small board-foot volume, but this will increase at a rapid rate as the young trees grow to sawlog size.

The upland hardwoods type, which occupies one-fourth of the forest area, has the smallest average volume per acre in all the sawlog-size conditions. The old-growth stands have a noticeably low volume and even the uncut second growth is deficient. Half of the type area supports under-sawlog-size stands. With careful management and reasonable use they should develop into well-stocked sawlog-size stands.



A.- PINE AND PINE-HARDWOOD TYPES



B.- HARDWOOD TYPES

FIGURE 11 - DISTRIBUTION OF AREA AND BOARD-FOOT VOLUME IN THE SAWLOG-SIZE CONDITIONS, CLASSIFIED ACCORDING TO VOLUME OF SAW TIMBER PER ACRE

Table 9. - Average board-foot volume per acre classified according to forest type and forest condition, 1937

Forest type	Sawlog size					Under sawlog size*	Weighted average of all conditions
	Old growth		Second growth		Weighted average		
	Uncut	Partly cut	Uncut	Partly cut			
	Board feet**						
Shortleaf pine-hdwds.	12,180	5,780	4,810	2,820	4,430	250	2,530
Loblolly pine-hdwds.	10,480	9,520	5,320	3,200	4,710	210	2,710
Virginia pine-hdwds.	8,840	4,560	3,780	2,870	3,600	180	1,660
Upland hardwoods	5,600	3,810	2,400	1,810	2,910	300	1,570
Bottom-land hdwds.	10,450	5,820	3,000	2,940	4,490	300	2,900
Average all types	9,100	5,080	4,260	2,710	4,040	250	2,230

*Includes reproduction.

**Net volumes by the International $\frac{1}{4}$-inch rule.

Cordwood Volume

Cordwood volumes are particularly significant because the forests of the Piedmont contain such a high proportion of young, small trees. This is evident from table 10, which shows the total volume in under-sawlog-size trees slightly exceeding the volume of sawlog material in saw-timber trees. In most other survey units of the southeast and south the sawlog volume predominates.

One-half of the cordwood volume, 36.7 million cords, is pine. The sawlog-size trees, including their upper stems, contain 62 percent of the volume, under-sawlog-size trees contain 34 percent, and cull trees only 4 percent. The proportion of the volume in small trees is much higher than in the pine forests of the Coastal Plain. Intensive use of saw timber has depleted the board-foot stand while land abandonment has paved the way for extensive stands of young second growth. Some of this young timber will die, some will be used for fuelwood or pulpwood, and a small proportion will be sawed into lumber prematurely, but the majority of it will contribute to the saw-timber growing stock.

Virginia pine makes up 7 percent of the total cordwood volume. As a rule this material is very poor in quality because the trees develop an excessive number of limbs. Clear lengths of stem-wood are rare and 15 percent of the total sound cordwood volume occurs in trees too rough to be used for anything but firewood. The proportionate volume in cull trees is greater than in any of the other pine species.

The hardwood volume, comprising one-half of the total cordwood, contains an exceptionally large proportion of under-sawlog-size trees and cull trees. Only 37 percent of the cordwood volume is contained in the stems and limbs of saw-timber trees, compared to 43 percent in the smaller sound trees and 20 percent in the culls. The hickories and sweetgum have the largest proportionate volume in under-sawlog-size trees while the "other hardwoods" and red and white oaks contain most of the cull volume.

Table 10. - Net cordwood volume of all sound material, 1937

Species-group	Sawlog-size trees		Sound trees under saw-log size	Cull trees	Total	Propor-tion of total
	Sawlog material	Upper stems				
	- - - - - - - - - -	- Cords -	- - - - - - - - - -			Percent
Pines:						
Shortleaf	12,255,900	2,931,400	8,114,400	617,700	23,919,400	33.0
Loblolly	4,053,500	895,800	2,167,000	146,900	7,263,200	10.0
Virginia	1,947,300	595,600	1,865,600	773,500	5,182,000	7.2
Other softwoods	130,000	6,900	217,200	7,500	361,600	0.5
Total	18,386,700	4,429,700	12,364,200	1,545,600	36,726,200	50.7
Hardwoods:						
Sweetgum	927,800	502,100	1,675,600	395,000	3,500,500	4.8
Yellowpoplar	1,446,500	794,400	1,928,800	243,600	4,413,300	6.1
Red oaks	1,931,100	972,600	2,622,600	1,260,100	6,786,400	9.4
White oaks	2,462,100	1,241,900	4,099,400	1,506,600	9,310,000	12.8
Hickories	844,200	438,400	1,988,200	524,900	3,795,700	5.2
Other hardwoods	1,069,300	543,700	3,079,700	3,239,300	7,932,000	11.0
Total	8,681,000	4,493,100	15,394,300	7,169,500	35,737,900	49.3
Total all species	27,067,700	8,922,800	27,758,500	8,715,100	72,464,100	100.0
Percent of total	37.4	12.3	38.3	12.0	100.0	

Volume by diameter-class: In table 11 the cordwood volume includes the entire stand of sound trees 5.0 inches d.b.h. and larger but it does not include the 13.2 million cords in cull trees or upper stems and limbs of sawlog-size hardwoods. About three-fourths of the pine volume and two-thirds of the hardwood is in trees less than 13.0 inches d.b.h. The red oaks have the highest proportionate volume in large trees and Virginia pine has the lowest. Pines in the 10- and 12-inch class, a desirable pulpwood size, make up one-fourth of the total cordwood volume in sound trees.

Table 11. - Net cordwood volume of sound trees classified according to species-group and diameter-class, 1937

Species-group	Tree diameter-class (inches)				Total	Proportion of total
	6 - 8	10 - 12	14 - 18	20 and over		
	Cords (bark included)					Percent
Pines:						
Shortleaf	8,114,400	9,911,000	4,537,100	739,200	23,301,700	39.3
Loblolly	2,167,000	2,539,500	1,761,100	648,700	7,116,300	12.0
Virginia	1,865,600	1,803,000	724,200	15,700	4,408,500	7.5
Other softwoods	217,200	79,700	35,700	21,500	354,100	0.6
Total	12,364,200	14,333,200	7,058,100	1,425,100	35,180,600	59.4
Hardwoods:						
Sweetgum	853,400	822,200	658,700	269,100	2,603,400	4.4
Yellowpoplar	794,100	1,134,700	988,600	457,900	3,375,300	5.7
Red oaks	1,135,200	1,487,400	1,245,200	685,900	4,553,700	7.7
White oaks	1,728,900	2,370,500	1,551,300	910,800	6,561,500	11.1
Hickories	841,900	1,146,300	670,300	173,900	2,832,400	4.8
Other hardwoods	1,716,700	1,337,700	787,900	306,700	4,149,000	6.9
Total	7,070,200	8,298,800	5,902,000	2,804,300	24,075,300	40.6
Total all species	19,434,400	22,632,000	12,960,100	4,229,400	59,255,900	100.0
Percent of total	32.8	38.2	21.9	7.1	100.0	

Volume per acre: The average stand of cordwood per acre, excluding cull trees and upper stems and limbs of sawlog-size hardwoods, is 11.9 cords (table 12). This is the average of all types and forest conditions, including the clear-cut areas and the reproduction and under-sawlog-size stands. The average stand in the Piedmont is about two cords less than the average stand in the Northern Coastal Plain and about two cords more than the average stand in the Southern Coastal Plain of North Carolina.

The sawlog-size stands average 18.4 cords per acre. The loblolly pine-hardwoods type has the largest average volumes per acre in the saw-timber conditions, although not greatly exceeding the shortleaf pine-hardwoods or bottom-land hardwoods types. Second-growth uncut stands in these pine types average about 23 cords per acre and occupy about one-third of the saw-timber area. The upland hardwoods type has the lowest average stand per acre in the sawlog-size conditions but exceeds the pine types in the under-sawlog-size conditions. Its average of 10 cords per acre represents the volume on one-fourth of all the forest land.

Table 12. - Average cordwood volume per acre, classified according to forest type and forest condition, 1937

Forest type	Sawlog size					Under sawlog size*	Weighted average of all conditions
	Old growth		Second growth		Weighted average		
	Uncut	Partly cut	Uncut	Partly cut			
	- - - - - -	- - - -	- - - -	- - - -	Cords - - - -	- - - -	- - - -
Shortleaf pine-hardwoods	34.2	20.1	22.5	15.2	20.1	4.6	13.1
Loblolly pine-hardwoods	36.8	28.8	24.6	16.4	21.1	3.9	13.4
Virginia pine-hardwoods	28.0	15.7	17.9	12.8	16.6	3.4	9.1
Upland hardwoods	19.1	14.9	13.7	11.1	13.7	6.1	9.8
Bottom-land hardwoods	33.7	20.2	18.0	16.9	20.1	6.4	14.9
Average all types	27.9	18.1	20.5	14.5	18.4	4.8	11.9

*Includes reproduction and clear-cut conditions.

Cubic-foot Volume

In table 13 the volume of sound wood in trees 5.0 inches d.b.h. and over, has been summarized in cubic feet because the cubic foot provides a more accurate measure of wood volume than either board feet or cords. The elimination of bark causes minor changes in the proportional distribution of the volume when compared to the cordwood estimates of table 10. Sound pine makes up 54 percent of the total cubic-foot stand, in contrast to 51 percent of the cordwood stand while sawlog material of both pine and hardwood comprise 40 percent of the total stand instead of 37 percent when measured in cords.

Table 13. - Net cubic-foot volume of all sound wood, without bark, 1937

Species	Sawlog-size trees		Sound trees under sawlog size	Cull trees	Total	Proportion of total
	Sawlog material	Upper stems				
	- - - -	- - - -	Thousand cubic feet	- - - -	- - - -	Percent
Shortleaf pine	888,010	210,280	549,000	43,670	1,690,960	35.1
Loblolly pine	290,780	63,420	141,290	10,240	505,730	10.5
Virginia pine	141,550	43,150	131,270	55,430	371,400	7.7
Other softwoods	9,860	500	16,060	560	26,980	0.6
Sweetgum	64,290	30,490	107,350	26,040	228,170	4.7
Yellowpoplar	96,670	46,450	122,810	15,840	281,770	5.8
Oaks	286,210	126,620	414,160	173,910	1,000,900	20.8
Hickories	56,350	25,660	127,190	34,010	243,210	5.0
Other hardwoods	71,550	31,880	195,940	171,140	470,510	9.8
Total	1,905,270	578,450	1,805,070	530,840	4,819,630	100.0
Percent of total	39.5	12.0	37.5	11.0	100.0	

Poles

Trees sold for poles usually bring a higher price than those sold for sawlogs. For this reason an estimate has been made of the number of shortleaf and loblolly pine trees suitable for poles (table 14). An unusually small proportion of the pole stand will make poles 35 feet or over in length; only 7.7 percent compared to 15.7 percent in the Northern Coastal Plain of North Carolina. Also nearly twice as great a proportion of the poles in this unit occur in trees of the 7.0 to 8.9-inch d.b.h. class. There appears to be no pronounced concentration of pole timber in the Piedmont. Pole trees were recorded least frequently in Anson, Franklin, Rockingham, Union, and Wake, and most frequently in Durham, Granville, Orange, and Person Counties.

Table 14. - Total number of pine poles, classified according to length and diameter, 1937

D.b.h. of trees (outside bark)	Pole length (feet)					Total	Proportion of total
	20	25	30	35	40 or over		
Inches	- - - - - - -	Thousand pieces	- - - - - - -				Percent
7.0 - 8.9	7,795	2,379	910	--	--	11,084	46.9
9.0 - 10.9	3,714	2,110	1,472	528	150	7,974	33.7
11.0 - 12.9	950	887	848	415	272	3,372	14.3
13.0 - 14.9	130	229	279	183	166	987	4.2
15.0 - 16.9	--	43	63	57	60	223	0.9
Total	12,589	5,648	3,572	1,183	648	23,640	100.0
Percent of total	53.3	23.9	15.1	5.0	2.7	100.0	

Increment is the net volume of wood produced by the growing stock of the forest. The board-foot growing stock consists of all sound pine trees 9.0 inches d.b.h. and larger and all sound hardwood trees 13.0 inches d.b.h. and larger. The cubic-foot growing stock includes all sound trees at least 5.0 inches d.b.h. The 2- and 4-inch trees becoming 5.0 inches or more during the increment period are included in cubic-foot tabulations of increment and the under-sawlog-size pines and hardwoods that become saw timber are included in board-foot increment. Neither the volume in cull trees nor that in the upper stems and limbs of sawlog-size hardwoods is considered growing-stock material.

The Interrelation of the Elements of Increment

Increment is the resultant of two opposing factors -- total growth and volume lost through mortality and decay. Total growth is composed of (1) the recruited volume created by small trees developing into merchantable sizes, (2) the volume added by growth to individual trees already of merchantable size, including growth on utilized trees up to the time of their removal from the stand. The effect of mortality and the two elements of total growth upon net board-foot and cubic-foot increment in the several forest conditions is illustrated in figure 12, where the total growth in each condition is represented by the 100 percent bar and mortality losses by the bar to the left of the zero line. Net increment is not shown directly but it is equivalent to total growth less mortality.

In both the pines and hardwoods a high proportion of the total growth is derived from the recruited volume. This is most noticeable in the under-sawlog-size stands, but recruited volume is also an important part of the total growth in the saw-timber conditions. About 56 percent of the total hardwood board-foot growth and 53 percent of the pine growth result from small trees growing into sawlog size. Compared to board-foot recruitment, the volume recruited into the cubic-foot stands makes up a smaller proportionate part of the total growth in practically all condition classes.

Mortality losses are proportionately greatest in the old-growth conditions. In the pine and hardwood saw timber, both old growth and second growth, the mortality loss is more than compensated by the volume recruited from the younger trees. The mortality in under-sawlog-size stands of both pine and hardwood is unusually low by comparison with similar stands in the Coastal Plain.

Increment of the Total Stand

In 1937 the total growth of the forest growing stock was 769 million board feet and the volume lost because of mortality amounted to about 60 million feet. Net increment was, therefore, approximately 709 million board feet (table 15), of which 73 percent was pine and 27 percent was hardwood. About three-fourths of the increment developed in sawlog-size stands and one-fourth in stands under sawlog size. Eighteen percent of the hardwood increment and 6 percent of the pine accrued in the old-growth condition.

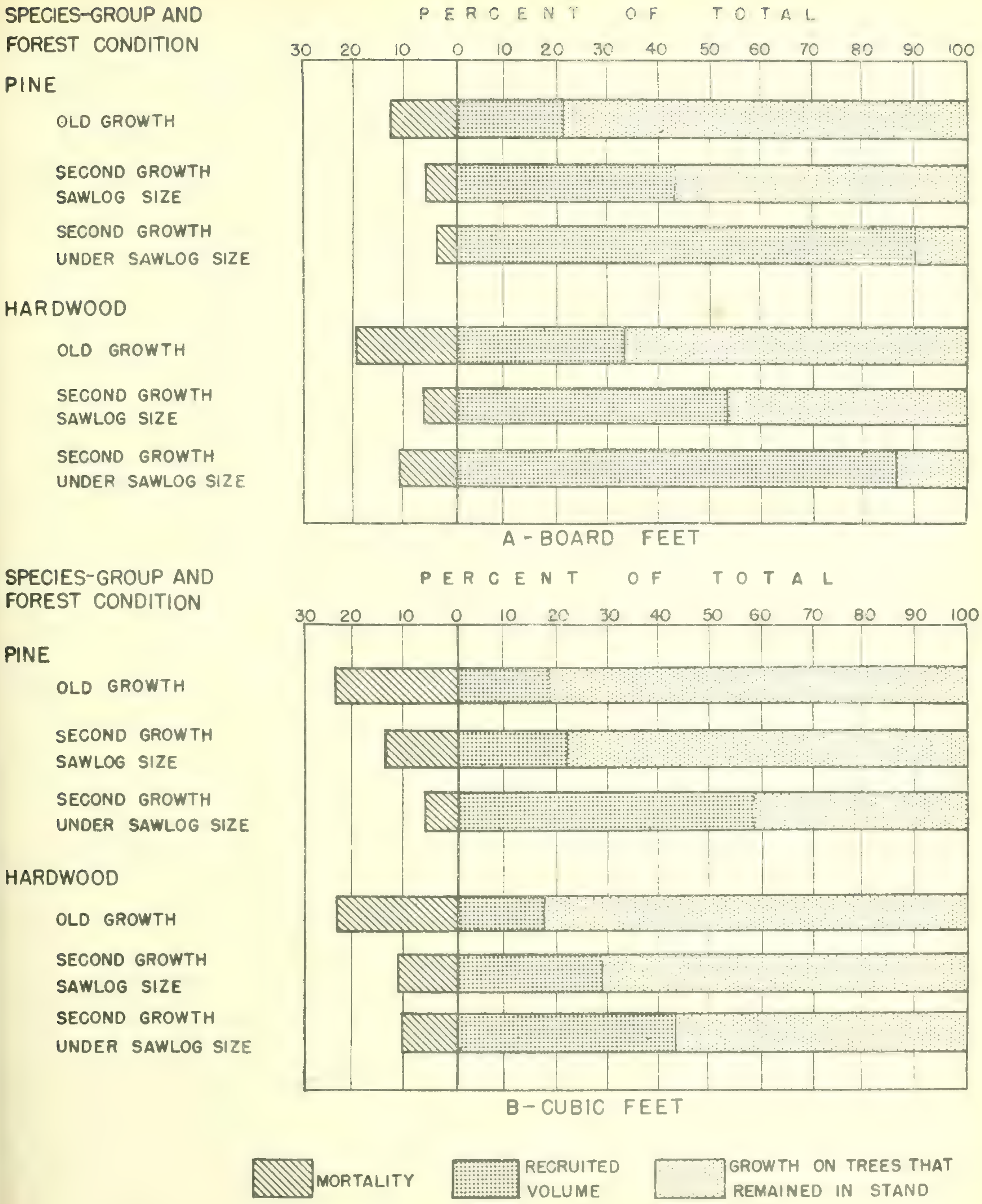


FIGURE 12-PROPORTIONAL DISTRIBUTION OF THE ELEMENTS OF NET INCREMENT, 1937

Table 15. - Net increment in board feet and cubic feet in the various forest conditions, 1937

Forest condition	Saw-timber material			All sound trees		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	Thousand board feet			Thousand cubic feet (i.b.)		
Sawlog size:						
Old growth	32,600	34,100	66,700	5,770	9,210	14,980
Second growth	356,200	114,500	470,700	78,580	38,210	116,790
Under sawlog size:						
Second growth	130,300	41,300	171,600	62,120	27,650	89,770
Reproduction	200	Negl.	200	40	20	60
Total all conditions	519,300	189,900	709,200	146,510	75,090	221,600

The increment of all sound trees 5.0 inches d.b.h. and larger amounted to 222 million cubic feet. When these smaller trees are included, the proportion of hardwood increment increases to one-third of the total because of the wider diameter range (5.0 to 13.0 inches) of under-sawlog-size hardwoods. The pine cubic-foot increment is equivalent to 2.1 million cords of wood with bark and the hardwood is equivalent to 1.2 million cords.

Increment per Acre

An estimate of the average annual increment per acre in the various forest types and conditions is presented in table 16. Since the values include the calculated full years growth in the trees utilized during 1937 they indicate the increment of uncut stands.

The average board-foot increment per acre in this unit is greater than in the Southern Coastal Plain but less than in the Northern Coastal Plain of North Carolina. The loblolly pine-hardwoods and shortleaf pine-hardwoods types are most productive. The second-growth uncut saw-timber stands of these two types have an average increment of more than 300 board feet per acre. This average represents the increment rate on 812,000 acres or 16 percent of the forest land. Three hundred feet per acre is better than average increment but it can be increased with forest management. In the three pine types there are 2.3 million acres on which the average annual increment is less than 200 board feet per acre. Nearly three-fourths of this area is stocked with reproduction and young second growth that is too young to produce much board-foot increment, but the other one-fourth supports sawlog-size stands in which the growing stock has been depleted. All of these stands need fire protection and freedom from cutting in order that the young trees and reproduction may replenish the growing stock. The average increment per acre in the upland hardwoods type, which occupies one-fourth of the forest land, is unsatisfactory in all conditions. It is deficient in quantity and also quality because part of the increment is in the less valuable species.

An average increment of .68 cords per acre for all forest land is unusually high, exceeding the increment in the Piedmont of South Carolina, Georgia, or Alabama. It is a result of growth upon the large volume of young trees which occur both as distinct age-classes and in mixture with older stems.

Table 16. - Average increment per acre classified according to forest condition and forest type, 1937

Forest condition	Saw-timber material						All sound trees in all types	
	Short-leaf pine-hdwds.	Lob-lolly pine-hdwds.	Virginia pine-hdwds.	Upland hdwds.	Bottom-land hdwds.	Average of all types	Includ-ing bark	Exclud-ing bark
	- - - - - - -	Board feet	- - - - - - -				Cords	Cu.ft.
Sawlog size:								
Old growth:								
Uncut	235	202	173	112	209	178	0.48	33.4
Partly cut	160	264	125	101	154	138	0.48	32.4
Second growth:								
Uncut	300	331	[illegible]	159	199	268	0.91	62.7
Partly cut	189	215	192	124	202	182	0.72	49.1
Under sawlog size:								
Second growth	89	83	73	72	66	81	0.63	42.0
Reproduction	1	2	1	--	--	1	Negl.	0.3
Weighted average	172	181	131	98	142	149	0.68	46.0

PRIMARY FOREST INDUSTRIES[4]

About [illegible] primary wood-processing plants were utilizing the timber stands of the Piedmont in 1937. The lumber industry predominates, but numerous plants manufacture veneer, furniture dimension stock, cooperage, tobacco baskets, handles, shuttle blocks, excelsior, and shingles. In addition, a considerable quantity of crossties, poles, and fuelwood are cut as well as smaller amounts of pulpwood and extract wood. Altogether nearly 900 million board feet of saw timber were used and 4-3/4 million man-days of labor were expended.

The Lumber Industry

In 1937 there were about 1,600 sawmills operating in the unit. The majority were small portable mills able to produce only a few thousand board feet per day under the most favorable conditions, as less than 30 mills had a daily cutting capacity of more than 10,000 feet. Most of the mills make rough lumber which is produced under contract for, or is sold direct to, concentration yards. These yards finish the lumber, sell some of it at retail to local consumers and the larger part at wholesale upon the general lumber market. The total cut of all the mills, including 168,000 sawn crossties, amounted to 624 million board feet, about 90 percent pine and 10 percent hardwood. Approximately 95 percent of the pine and 80 percent of the hardwood was cut from second-growth saw timber.

About 50 sawmills in 18 counties brought 34 million board feet of pine sawlogs and 5.3 million feet of hardwoods into the unit for lumber manufacture. Of the pine, about one half came from the Coastal Plain and one-fourth from the mountains of North Carolina, and the remaining one-fourth chiefly from Virginia. Only one-fifth of the hardwood was drawn from the Coastal Plain, three-fifths was brought from the mountains and one-fifth from Virginia and South Carolina. About five million board feet of pine sawlogs and one-fourth of a million feet of hardwoods were shipped out of the unit to sawmills in the Coastal Plain and two million feet of pine sawlogs from the Piedmont were used by mills in the mountain region. The movement of sawlogs into the unit exceeded the movement out by 32 million board feet.

Small portable mills: Almost 95 percent of the pine and hardwood lumber was produced by 1,572 small mills that cut less than 10,000 board feet per day. The average small mill cut 365,000 board feet during the year and operated about 80 days. Both the production and operating time vary widely between mills, however, because many are operated by farmers who cut lumber only in their spare time, while others are operated practically full-time by experienced lumbermen. Most of the mills buy stumpage, some do contract or custom sawing, and a very few operate in their own timber. Hardly any of these small mills buy logs delivered at the plant.

The typical mill employs four men in the woods and four in the plant. Frequently the same crew does both logging and milling. The mills are

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[4] Based on data gathered in cooperation with the U. S. Bureau of the Census.

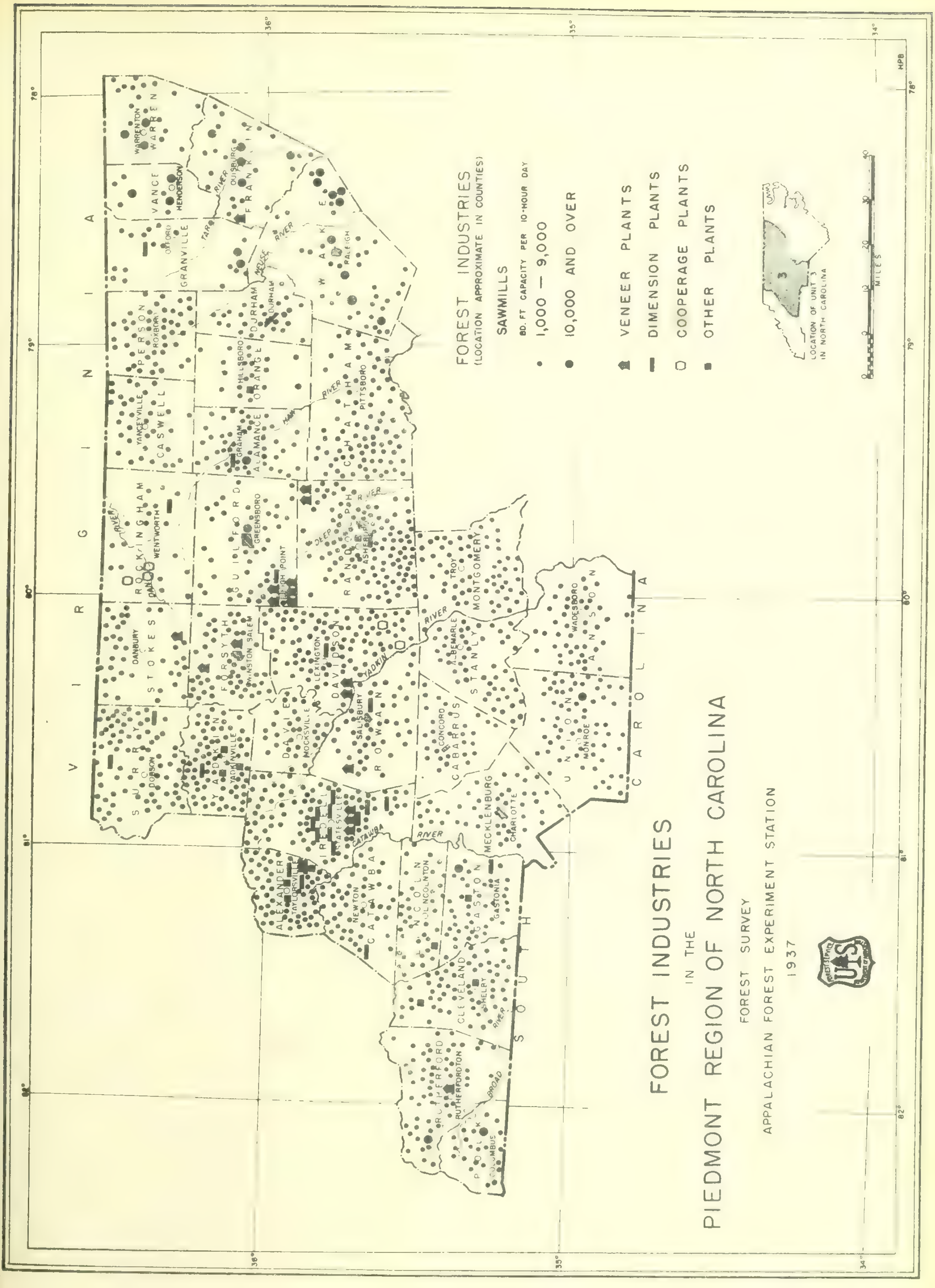
FOREST INDUSTRIES
IN THE
PIEDMONT REGION OF NORTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1937
FOREST INDUSTRIES
(LOCATION APPROXIMATE IN COUNTIES)
SAWMILLS
BD. FT CAPACITY PER 10-HOUR DAY
• 1,000 — 9,000
● 10,000 AND OVER
VENEER PLANTS
DIMENSION PLANTS
COOPERAGE PLANTS
OTHER PLANTS
LOCATION OF UNIT 3 IN NORTH CAROLINA
MILES
VIRGINIA
SOUTH CAROLINA
WARREN
VANCE
GRANVILLE
FRANKLIN
WAKE
DURHAM
PERSON
ORANGE
CASWELL
ALAMANCE
CHATHAM
ROCKINGHAM
GUILFORD
RANDOLPH
MONTGOMERY
STOKES
FORSYTH
DAVIDSON
STANLY
ANSON
SURRY
YADKIN
DAVIE
ROWAN
CABARRUS
UNION
ALEXANDER
IREDELL
CATAWBA
LINCOLN
GASTON
MECKLENBURG
CLEVELAND
RUTHERFORD
POLK
WARRENTON
HENDERSON
OXFORD
LOUISBURG
RALEIGH
ROXBORO
HILLSBORO
PITTSBORO
YANCEYVILLE
GRAHAM
WENTWORTH
GREENSBORO
HIGH POINT
ASHEBORO
TROY
DANBURY
WINSTON SALEM
LEXINGTON
ALBEMARLE
WADESBORO
DOBSON
YADKINVILLE
MOCKSVILLE
SALISBURY
CONCORD
MONROE
TAYLORSVILLE
STATESVILLE
NEWTON
LINCOLNTON
CHARLOTTE
GASTONIA
SHELBY
RUTHERFORDTON
COLUMBUS
TAR RIVER
NEUSE RIVER
HAW RIVER
DEEP RIVER
DAN RIVER
YADKIN RIVER
CATAWBA RIVER
BROAD RIVER
78°
79°
80°
81°
82°
36°
35°
34°
HPB

Figure 13

usually moved when the log haul approaches one-half mile in distance. Because the mills stay in the timber, many of the logs are skidded directly to the plant by team, but some are brought in with high-wheels pulled by a team or tractor. Trucks are usually used for the infrequent long hauls. As a rule the mill consists of a saw carriage, circular saw, and power unit. Occasionally a mill will have an edger and very infrequently a planer. About two-thirds of the plants use motors for power, either tractors, old automobile engines, or Diesel units averaging about 42 horsepower. Steam engines, averaging about 32 horsepower, are used in practically all of the other mills, although a very few mills are powered with electricity. Most all of the lumber produced by these small mills is sold unfinished at an average price of $10 to $15 per thousand, mill run. Much of it is "roofer" material but part of that sold to concentration yards is re-sawed into graded stock at the yard.

Semi-permanent mills: Only five percent of the lumber was cut by the 28 sawmills with capacities of more than 10,000 board feet per day. Nearly half of these mills are semi-permanent, having stayed in the same location several years, the remainder move about twice a year. Their average cut was 1,550,000 board feet and they operated about 170 days in 1937. Half of the lumber was cut from stumpage purchased by the mill operator, 40 percent was cut on contract for concentration yards, and 10 percent was cut from logs delivered on the yard. The cut of these mills, like that of the smaller portables, was about 90 percent pine.

It required about 7 men in the woods to provide logs for the average mill, which operated with 9 men. The woods and mill crews are usually distinct, and often the logging is done on contract. Teams and tractors are used to skid the logs which are carried to the more stationary mills by truck. The contract mills usually move to the timber and skid direct to the mill with tractors and high-wheels. All of the sawmills use circular saws, three-fourths use edgers, about one-fifth use cut-off saws and planers, and very few have dry-kilns. Steam engines of 50 to 100 horsepower are used in two-thirds of the mills, tractors, gasoline or fuel oil engines, and electric motors power the remainder. Almost three-fourths of the lumber produced by these mills is unfinished.

Concentration yards and planing mills: In this report both concentration yards and planing mills are considered secondary forest industries and no attempt is made to present exact data concerning their number or location. They are, however, an integral part of the lumber industry in this unit, bridging the gap between the rough lumber of the portable mill and the dressed lumber and millwork of the retail yard.

Approximately one-third of the small portable sawmills are cutting rough lumber under contract to about 70 concentration yards and planing mills. These concerns handle 50 percent of the pine and about 40 percent of the hardwood lumber cut in the unit. They serve as middlemen, providing a ready market for the rough lumber of the small mills, occasionally financing the purchase of sawmill equipment, and often advancing money for stumpage. Usually they buy the lumber on a mill-run basis and remanufacture it to sell on a grade basis. Because of their control over the small-mill operator they can exert a strong influence upon his cutting practices.

Monetary importance of sawmills: In terms of dollars the sawmill industry is small compared to textile or tobacco manufacturing. The money distributed is important nevertheless, because it provides a livelihood to several thousand workers and an increased income to many farmers, merchants, and equipment manufacturers. The following estimate of the value of wages, raw material, fuel, repairs and replacements, and product is based upon a sample of about 10 percent of the mills. The range of mills sampled extended from the small family-operated custom sawmill to the semi-permanent steam mill making dressed lumber and millwork. On this basis it is estimated the 1,600 sawmills in the unit paid 2.4 million dollars in wages to sawmill and woods workers. About half of this amount was paid by the mills cutting less than 500,000 board feet per year which comprise three-fourths of the mills in the unit. Slightly over 2.5 million dollars were given for stumpage and one-fourth of a million dollars for logs delivered at the mill yard. Fuel, chiefly gasoline and fuel oil, cost nearly $300,000. Approximately $400,000 was spent for repairs, new or used sawmill equipment, teams, motor trucks, and tractors. These expenditures, totaling nearly 6 million dollars, cover part of the costs incurred in producing lumber valued at about 8 million dollars. Total production costs would also include rent, taxes, interest, insurance, plant depreciation and profit margin.

Other Forest Products

Veneer: The furniture factories of North Carolina require a large quantity of veneer and part of it is made by the veneer plants operating in this unit. Eighteen plants used 26.6 million board feet of hardwood veneer logs in 1937. About two-thirds of this volume was yellowpoplar, one-fourth was sweetgum, and the remainder was white oak, blackgum, walnut, maple, and sycamore. Approximately three-fourths of the veneer logs were cut from old-growth timber. The forests of the Piedmont supplied one-half of the veneer bolts, 12 percent came from the Coastal Plain, 30 percent came from South Carolina and the remainder from Virginia and Georgia. Practically all of the mills buy logs delivered at the mill yard.

In 1939 the average cost of delivered veneer bolts was $25.50 per thousand board feet and labor costs at the mill averaged about $21 per thousand board feet of consumption. Power was supplied by coal-fired steam engines and numerous electric motors at a cost, for coal and electricity, of $1.25 per thousand board feet utilized. The expenditures for equipment and repairs averaged $1.70 per thousand. These costs, which do not include plant depreciation, interest, taxes, or insurance, total about $50.00. On the average, a thousand board feet of bolts produced 9,000 square feet of veneer which sold for about $80.00. On this basis the 1937 production was worth two million dollars.

Hardwood dimension stock: In 1937 furniture dimension stock was made by 18 small plants. They used 6.8 million board feet of hardwood, chiefly hickory, white oak, and yellowpoplar, with some maple, birch, and ash. Three-fourths of the timber was second-growth. Practically all of the logs were cut within the unit and 90 percent of the log volume was purchased delivered at the yard.

The plants are usually small, seldom employing more than five men. The mill equipment is simple, consisting of a circular saw, rip saw, and cut-off saw. Electric motors are frequently used for power. Logs cost about $20.00 per thousand delivered at the mill or $8.00 to $10.00 on the stump. When manufactured into rough squares poplar, ash, birch, and black gum sell for about $40.00 to $60.00 per thousand board feet.

Cooperage: Both the tight and slack cooperage industries are represented in this unit. Two mills make tight staves using white oak and three mills make pine staves for tobacco hogsheads. Their total consumption was about one million board feet of logs. Three-fourths of the white oak was old-growth timber, but all of the pine was second growth. The white oak is purchased delivered at the tight stave mills, each of which are operated by 12 employees. The tobacco stave mills employ about 4 men in the woods and 4 at the plant.

Tobacco baskets: Yadkinville, in Yadkin County, is the center of tobacco basket production in North Carolina. In 1937 the three plants operating in the county made about 250,000 baskets. Hand-riven red and white oak splits are used for all of the basket except the rim, which is made of sawn lumber. The splits are made by farmers of the surrounding counties, who received about $45,000 for the five million splits made in 1937. About 1.5 million board feet of red and white oak logs were used for the splits and one-half a million board feet of lumber for the rims.

Handles and shuttle blocks: Six plants made handles and two made shuttle blocks in 1937. Plant capacities ranged from one-fourth cord to 10 cords per day and employees from 3 to 27 per mill. Altogether they used about 4,200 cords of hickory, poplar, dogwood, and maple. One handle plant made broom and mop handles exclusively from poplar and maple, the other five plants used second-growth hickory to make all kinds of tool and implement handles. The two shuttle block mills used dogwood entirely. In all of these plants the wood was purchased, delivered at the mill, from local farmers.

Shingles and excelsior: Approximately 700,000 shingles were made by the seven shingle mills operating in the unit in 1937. They used about 140,000 board feet of second-growth pine. Most of the mills are a permanent part of their community, staying at the same location year after year, making shingles on a custom basis for local use only. Each mill can make only five to ten thousand shingles per day and usually employs about four men.

The three excelsior plants used about 3,000 cords of second-growth pine and yellowpoplar in 1937. Yellowpoplar, however, makes up only a small proportion of the total consumption. The peeled wood is purchased by the cord, delivered at the mills which have a capacity of about five cords per day. The average mill employs 15 men.

Fuelwood: Only the lumber industry uses more wood than is consumed each year for fuel. The estimated total consumption of fuelwood in 1937 amounted to 2,600,000 cords, about two-thirds pine and one-third hardwoods. One-half of the wood was obtained from sawmill slabs, cull trees, and tops, and the rest from the sound-tree growing stock. Farmers used 63 percent of the fuelwood for heating and cooking and an additional 13 percent for curing tobacco. Fifteen percent was used by rural families not on farms and 9 percent by urban dwellers, schools, and small commercial establishments. The average farm family used 13.8 cords of wood for domestic purposes and 2.7 cords for curing tobacco. The farmers obtain most of their wood from their own woodlands and consequently do not have to make cash expenditure for this fuel. The contribution of fuelwood to the farm income amounts to at least four million dollars, however, while the value of fuelwood used elsewhere approximates one million dollars.

Hewn crossties: About 576,000 hewn crossties were purchased in the unit by 17 public-carrier railroads in 1937. Only 1,400 of these ties were pine, practically all of the rest were white and red oak. Most of the hewn ties purchased were class 5 (7" x 9" x 8'6"). Hardwood ties of this size sold for 80 to 90 cents each delivered at the railroad in 1938. The smallest size, class 1 (6" x 6" x 8'6"), sold for 25 to 35 cents F.O.B. railroad. At 75 cents each the 575,000 hewn crossties brought the farmers and woodsworkers of the unit about $430,000.

Other products: Treating plants purchased most of the 16,000 pine poles and piles sold in this unit in 1937. Poles with an average top diameter of 8 inches and a length of 35 feet accounted for a high proportion of the production, while most of the piles were in 20- and 50-foot lengths.

About 14,000 cords of pine pulpwood were obtained from the Piedmont by pulp mills in Virginia and the Coastal Plain of North Carolina. Also 500 cords of distillation wood were sold in Tennessee. Wood used for miscellaneous farm construction and maintenance, in the form of poles, fence posts, and round timbers amounted to approximately 60,000 cords. All of these products, including poles and material used on farms, had a value at loading point of about $150,000 in 1937.

Employment

The primary forest products industries furnished about 4.8 million man-days of employment in the mills and woods in 1937 (table 17). Seventeen percent, 829,000 man-days, was in the 1,662 forest products plants, as distinct from woods employment. The total number of men working in these plants was approximately 7,450. About 6,380 worked in sawmills, 720 worked in veneer plants, 90 in dimension stock mills, and the rest in handle, shuttle block, tobacco basket, cooperage, excelsior, and shingle mills. The wage rate in 1937 was not in excess of 25 cents per hour and at this rate the mill employees received about two million dollars in wages.

Eighty-three percent of the total employment was woods work, but four-fifths of this labor was expended in the production of fuelwood and other material for home use. Only 777,000 man-days were utilized in the production of sawlogs, bolts, basket splits, crossties, poles, and pulpwood. The total number of men employed is difficult to ascertain in this region where most of the woods work is done by farmers and small contractors. Part-time work is common and one full-time job may provide work for several different men during the course of a year. If each man worked 225 days per year, 3,450 men could produce the amount of wood used. It is probable, however, that about 6,000 individuals cut sawlogs for the sawmills and about 2,000 logged material for the other industries. The income of these 8,000 woods workers was about 1.5 million dollars in 1937.

Table 17. Production and employment in the primary forest industries, 1937

Commodity	Number of plants	Material cut in woods	Produced or used by plants	Employment provided		
				In woods	In plants	Total
		Thousand board feet		Thousand man-days*		
Lumber	1,600	592,400	624,300	592	678	1,270
Veneer	18	14,900	26,600	40	96	136
Furniture dimension	18	6,800	6,800	10	19	29
Cooperage	5	3,600	1,100	7	3	10
Tobacco baskets	3	1,500	1,500	15	11	26
		Thousand pieces				
Poles and piles	--	16	--	4	--	4
Hewn crossties	--	576	--	81	--	81
		Thousand cords				
Fuelwood	--	2,592	--	3,110	--	3,110
Misc. farm use	--	60	--	66	--	66
Handles and shuttle blocks	8	3	4	9	14	23
Misc. mfg. products**	10	17	3	19	8	27
Total	1,662	--	--	3,953	829	4,782

*Man-days equal 10 hours.

**Seven shingle mills, 3 excelsior mills, pulpwood and distillation wood.

COMMODITY DRAIN

The commodity drain from the pine and hardwood sound-tree growing stock includes both the material utilized and the sound merchantable material left in felled trees. The drain on the saw-timber portion of the trees, including both the utilized and wasted portions, is expressed in board feet, whereas the volumes given in cubic feet and cords include drain on saw-timber material, upper stems of sawlog-size pines, and small trees ranging from 5.0 inches d.b.h. to sawlog size. The drain on hardwood tops is not included.

The drain upon saw-timber material amounted to 703 million board feet of pine and 183 million feet of hardwood in 1937 (table 18). About 690 million feet of pine were used by local forest industries and domestic consumers and 13 million board feet were shipped to sawmills in the Coastal Plain of North Carolina and cooperage and pulp mills in Virginia. Woods waste was negligible in the pine species. Nearly 172 million feet of the hardwood drain were used within the unit, slightly over one million board feet were taken to veneer plants in South Carolina, and about nine million board feet were left unutilized as woods waste.

About 85 percent of the pine and 60 percent of the hardwood cubic-foot drain was obtained from saw-timber trees. Pine trees under 9.0 inches d.b.h. were cut primarily for pulpwood, fuelwood, and miscellaneous farm use, while most of the hardwoods less than 13.0 inches were used for fuelwood. Old-growth stands provided 10 percent of both the pine and hardwood drain, second-growth sawlog-size stands 80 percent of the pine and 70 percent of the hardwood, and under-sawlog-size stands 10 percent of the pine and 20 percent of the hardwood. A high proportion of the drain upon the total sound-tree growing stock was caused by the local demand for fuelwood. About one-third of the pine and one-half of the hardwood was cut for this use.

Table 18. - Commodity drain from the sound-tree growing stock, 1937

Commodity	Saw-timber material			All sound trees*		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	Thousand board feet			Thousand cubic feet		
Lumber	520,400	72,000	592,400	111,470	12,580	124,050
Veneer	100	16,200	16,300	30	2,830	2,860
Furniture dimension	100	7,400	7,500	20	1,300	1,320
Handles and shuttle blocks	--	1,200	1,200	-	230	230
Cooperage	3,000	700	3,700	640	120	760
Tobacco baskets	--	1,700	1,700	--	290	290
Poles and piles	1,900	--	1,900	410	--	410
Crossties	100	37,400	37,500	20	6,530	6,550
Fuelwood	170,000	43,600	213,600	61,030	27,420	88,450
Misc. farm use	3,800	2,300	6,100	2,150	1,070	3,220
Misc. mfg. products	4,000	200	4,200	1,170	50	1,220
Total	703,400	182,700	886,100	176,940	52,420	229,360

*Total drain from growing stock expressed in cords of wood with bark: 2,474,000 of pine; 811,100 of hardwood.

COMPARISON OF INCREMENT WITH COMMODITY DRAIN

To be continuously productive a forest must grow an equal or greater amount of wood than is removed through natural and artificial causes. Otherwise the forest will be gradually depleted and the dependent industries and population will lack needed raw material. Both the natural and man-caused drain upon the forest fluctuates from year to year with changing conditions. Increment and drain comparisons for a single year are, therefore, unreliable for predicting long-time trends in the forest situation. A surplus of increment over drain does not, of itself, imply that the cut can be correspondingly increased. Conversely, when the drain exceeds the increment there is not always cause for alarm because the excessive cut may be temporary or there may be a large reserve of young timber just coming into production. Conditions within each survey unit must be judged by other factors than end figures in a comparison of increment and drain.

Comparison in Board Feet

The pine growing stock decreased 184 million board feet in 1937 (table 19). Total growth was less than commodity drain and even the elimination of all mortality losses through fire protection and intensive utilization would still leave drain greater than net increment. Along with the reduction in growing stock there was a continuous replacement of the older and larger trees with young second-growth of minimum saw-timber size.

Table 19. - Comparison between increment and drain of saw-timber material, 1937

Item	Pine	Hardwood	Total
	- - - - - Thousand board feet - - - - -		
Net growing stock, Jan. 1, 1937	7,673,600	3,410,000	11,083,600
Growth, 1937	557,000	211,700	768,700
Mortality, 1937	37,800	21,700	59,500
Net increment, 1937	519,200	190,000	709,200
Commodity drain, 1937	703,400	182,700	886,100
Net change in growing stock, 1937	-184,200	+7,300	-176,900
Net growing stock, Jan. 1, 1938	7,489,400	3,417,300	10,906,700

The pine drain in the old-growth condition was 2.7 times the increment and the drain in second-growth saw-timber was 1.7 times the increment. Only in the under-sawlog-size stands was increment greater than saw-timber drain, exceeding it five to one, but this surplus was not great enough to compensate for the over-cut in the saw-timber conditions. Volume recruited from these under-sawlog-size stands and from young trees in saw-timber stands amounted to one-half of the total growth. The diameter distribution of the young trees in this unit does not indicate any appreciable increase in the amount of recruited volume and the pine board-foot growing stock will continue to decrease unless the commodity drain is reduced by at least one-fourth.

The slight increase in the hardwood board-foot growing stock is inconclusive. It shows the board-foot drain was less than the increment but gives no indication of the situation within species-groups. For example, about 75 percent of the commodity drain was red and white oak, 15 percent was yellowpoplar, 5 percent was sweetgum and blackgum, and 5 percent was hickory, maple, ash, birch, and sycamore. Increment was not determined for individual species but estimates of its distribution are as follows: red and white oaks 55 percent, sweetgum and blackgum 15 percent, yellowpoplar 20 percent, and miscellaneous hardwoods 10 percent. Because the volumes of increment and drain are approximately equal it is apparent the increment of red and white oak was insufficient to meet drain requirements while the increment of the other species-groups exceeded drain. Even with a surplus of increment yellowpoplar may not be producing enough high-quality material for the veneer industry.

Comparison in Cubic Feet

Including the increment and drain upon the under-sawlog-size trees does not change the situation materially for the growing stock of sound pine trees, 5.0 inches d.b.h. and larger, decreased by 30 million cubic feet and the hardwood growing stock increased by nearly 23 million cubic feet (table 20).

Table 20. - Comparison between increment and drain of all sound material, 1937

Item	Pine	Hardwood	Total
	- - Thousand cubic feet (i.b.) - -		
Net growing stock, Jan. 1, 1937	2,485,170	1,542,520	4,027,690
Growth, 1937	166,430	86,280	252,710
Mortality, 1937	19,920	11,190	31,110
Net increment, 1937	146,510	75,090	221,600
Commodity drain, 1937	176,940	52,420	229,360
Net change in growing stock, 1937	-30,430	+22,670	-7,760
Net growing stock, Jan. 1, 1938	2,454,740	1,565,190	4,019,930

In table 21 the change in growing stock values of table 20 have been broken down to show in which forest conditions and tree-sizes the losses and gains have occurred. There was a loss in volume of both small and large pines in the saw-timber conditions and a gain throughout the diameter range in the under-sawlog-size condition. Pine trees less than 9.0 inches in diameter increased by only 6.5 million cubic feet while saw-timber trees decreased nearly 6 times this amount. The volume of hardwoods below saw-timber size increased in all conditions. Although the total volume of hardwood saw-timber material is increasing it is decreasing in the second-growth sawlog-size stands where it is commercially important.

Table 21. - Change in growing stock by forest conditions, 1937

Forest condition	Pine trees			Hardwood trees		
	5.0 - 8.9 inches d.b.h.	9.0 inches d.b.h. and larger	Total	5.0 - 12.9 inches d.b.h.	13.0 inches d.b.h. and larger	Total
	- - M cu.ft. (i.b.) - -			- - M cu.ft. (i.b.) - -		
Old growth	-750	-12,240	-12,990	+3,000	+850	+3,850
Second growth:						
Sawlog size	-7,680	-56,180	-63,860	+7,130	-4,920	+2,210
Under sawlog size	+14,960	+31,460	+46,420	+8,220	+8,390	+16,610
Total all conditions	+6,530	-36,960	-30,430	+18,350	+4,320	+22,670

Comparison in Cords

In figure 14 the total growth, mortality and commodity drain, and change in growing stock is presented for the pines and hardwoods by forest condition. The situation parallels that previously given in cubic feet. The net result is a loss of 371,000 cords in the pine growing stock and an increase of 366,000 cords in the hardwood stand.

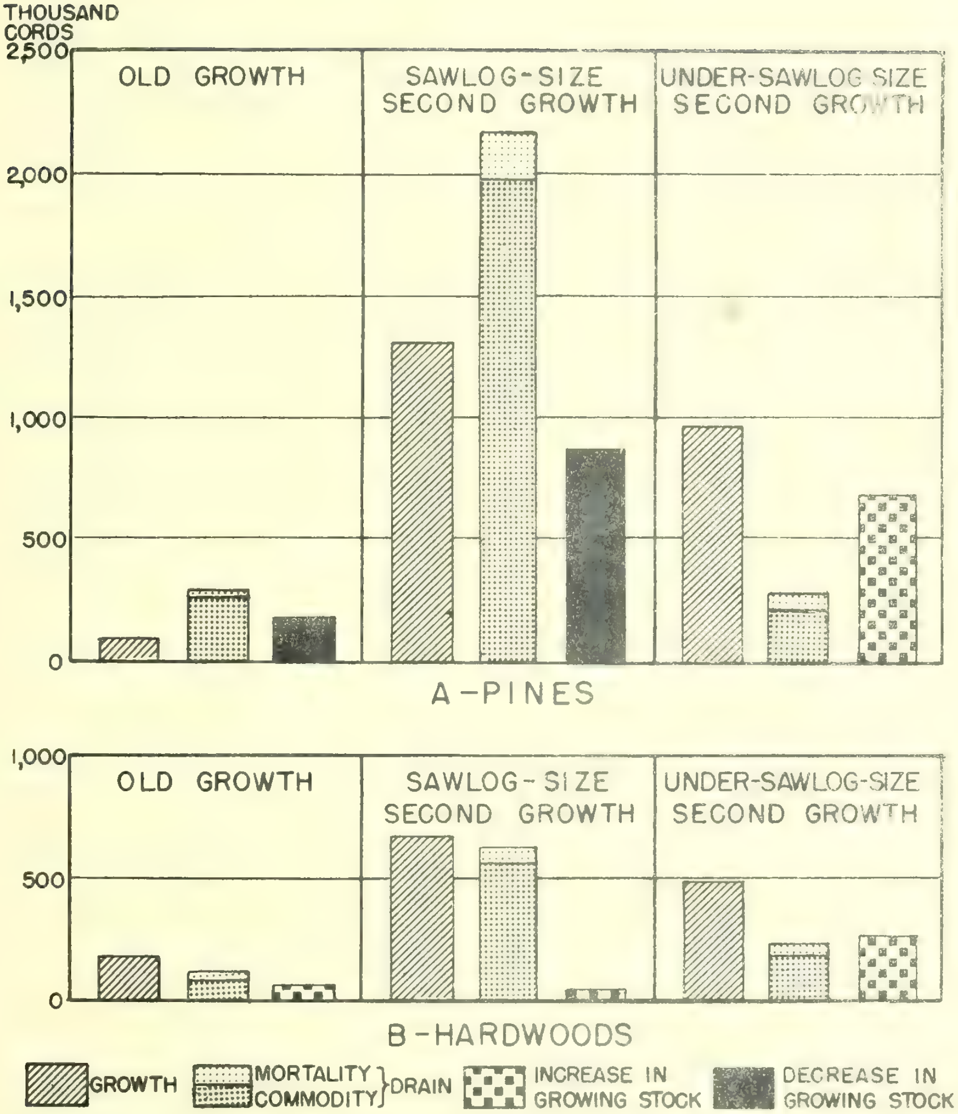

FIGURE 14-COMPARISON OF GROWTH WITH MORTALITY AND COMMODITY DRAIN BY FOREST CONDITIONS, 1937

FOREST PROBLEMS AND REMEDIAL MEASURES

The forest problems of the Piedmont are essentially those concerned with land use, forest production, and forest products utilization. The objective of remedial measures should be full development of the forest resource, in harmony with the development of other resources, to the end that forest land will contribute its full share to the economic support of the region.

Land Use

Changing trends in agriculture have a definite influence upon the forest situation in the Piedmont because 85 percent of the forest land is in farm ownership. During the past 35 years the number of farms has increased by one-fourth and the farm acreage has decreased about one-tenth. Yields of agricultural crops per acre have increased while markets have decreased. This is especially true of tobacco and cotton, the two most important crops in this unit. Crop control programs have also changed the pattern of land use toward less land in cultivation. An increasing amount of land is, therefore, becoming available for grazing, forests, or other uses. How to make the most productive use of this land is a problem of vital importance.

Existing deficiencies in products of the land afford an approach to the problem. Because of the general dependence upon cotton and tobacco for a cash income the farmers of the Piedmont have failed to grow enough vegetables, fruit, grain, meat, and dairy products for the rapidly increasing population. Likewise, timber production is not equal to the consumption of the numerous forest products industries. Obviously there is need for a reorganization of land use practices in order to provide more farm produce for local consumption and more wood for use by local industries. Good farm land should be used for agriculture and marginal land for timber production. The land in individual farms should be classified and allocated to its best use, and practices on each farm should be harmonized with those of the neighborhood, county, and region. Probably the best way of obtaining a comprehensive land-use plan is by means of county planning committees similar to those now functioning in a few counties of the State. The United States Department of Agriculture aids in the organization of these committees and provides advice and assistance to the various action programs. With a definite land use plan for each county of the Piedmont more efficient production of farm and forest crops would be facilitated.

Forest Production

Irrespective of any possible changes in the forest area through improvements in land use there still exists the problem of increasing forest production to provide for the needs of local users. This can be accomplished through (1) more intensive fire protection, (2) improvement in the quality and quantity of the growing stock, (3) management practices designed to cope with hardwood invasion, and (4) a more intensive farm forestry program.

Fire protection: Forest fires damage the standing timber and serve as a strong deterrent to the practice of forestry, thus reducing forest productivity. Fires are a less serious problem in the Piedmont than in other parts of the State but there is still the necessity to reduce fire losses. In the 1937-38 season only one-third of the forest land was under organized protection. Intensive protection may not be economically justifiable in a few of the most agricultural counties but in general the fire control division of the North Carolina State Forest Service should provide protection to the farm woodlands of the Piedmont as rapidly as the necessary funds can be obtained.

Improvement of growing stock: For greater productivity the volume of growing stock per acre should be increased and for greater financial returns the quality of the growing stock should be improved. Practical forest management will be required to correct these deficiencies. In general this management should attempt to increase the total quantity of pine and hardwood growing stock by at least one-third, to develop a greater proportion of the pine volume in large trees, and to increase the yield of high-quality hardwoods.

Planting will be necessary on certain areas, thinning on others. Improvement cuttings should be made in both pine and hardwood stands to remove the slow-growing, badly-formed, poor-risk trees. Virginia pine should be cut along with shortleaf pine to avoid reseeding the land to this less valuable species. A greater proportion of the fuelwood should be cut from poor-quality hardwoods and from the tops of trees felled for other uses. Premature cutting of young pines should be stopped and part of the annual increment of both pines and hardwoods should be left unutilized to build up the growing stock.

Farmers will be largely responsible for these improvements because they own most of the forest land. With proper guidance they can go a long way in developing the forest stands of the unit. Most of them live near their small forest tracts and in their spare time they can cut cull material usable on the farm for fuelwood, fence posts, and rough building material. Improvement of the growing stock should be facilitated under these conditions.

Hardwood invasion: The pine species are the chief support of the present lumber industry in the Piedmont. Most of the pine is growing upon land that would normally support a climax hardwood type. Evidence points toward a gradual replacement of the pines by the hardwoods, which, if extensive, will eventually greatly reduce the importance of the pine lumber industry.

Now is the time to recognize this threat of hardwood invasion and to start working out appropriate management policies. To date there is no concensus of opinion among foresters in regard to the best way to manage the pine forests of the Piedmont. Some advocate cleanings in young pine-hardwood stands to release pine crop trees from hardwood competition and heavy cutting of mature pine stands with dependence upon seed trees for reseeding the land to pine. Others favor a system of selective cutting similar to that practiced in Arkansas, Alabama, and other states of the Deep South. In either case the problem of hardwood utilization ranks high in importance.

Obviously it is beyond the scope of the Forest Survey to work out the answers to the many silvicultural and utilization problems. Sound recommendations cannot be made until comprehensive research is initiated and followed through by forest management specialists.

Farm forestry: The attainment of improved forest practices and increased forest production throughout the Piedmont depends in a large measure upon the cooperation of the farm operators. In the past many farmers have not appreciated the benefit to be derived from systematic cropping of their farm woodlands and forest values have been dissipated. Activities of the public forestry agencies have, of financial necessity, been rather extensive in character and as a result only a small proportion of the farmers have received help on their individual forest problems. The services now provided by public agencies both State and Federal, should be intensified and new services should be provided.

Specifically, the following forms of public assistance would contribute materially to the development of farm forestry in the Piedmont: (1) a county forester organization working in individual or groups of counties through established State and Federal extension systems, (2) a wide application of the provisions of the Cooperative Farm Forestry Act, which has as an objective the intensive development of the farm woodland into a productive unit of the farm, (3) forest credit supplementing that now available from Federal Land Banks, and (4) financial provision for more adequate fire protection and an enlarged tree planting program.

Forest Products Utilization

The need for developing the general utility of wood is fully as great as the need for increasing forest production. In the Piedmont the problem is not one of increasing the total consumption of wood, rather it is one of making adjustments in wood utilization practices. Consideration should be given to the problems presented by the portable sawmills, to the development of uses for low-grade hardwoods, and to more orderly marketing of forest products.

Portable sawmills: No other area in the southeast has a greater concentration of portable sawmills. In fact, the wood requirement of the great number of mills operating in 1937 greatly exceeded the growth capacity of the forest. In order to achieve a balance between growth and drain it will be necessary to reduce the number of mills or their total cut.

Part of the mills cut lumber for farm maintenance, part are custom mills sawing lumber on a fee basis for local use, but the majority are commercial mills sawing rough lumber for concentration yards. The farm and custom mills fill an important place in their communities, producing low-cost building material from home-grown timber. The commercial mills provide convenient markets for saw timber, widely-distributed employment, and a workable system of utilizing timber volumes held in small scattered stands. As operated at present, however, they constitute a serious obstacle to efficient forest production and utilization because they cut the young timber before it is financially mature and usually leave the cut-over stand in poor condition for future growth.

There are several ways of improving small mill practices. One of these is through an approach to the land owners. Intensive advice and assistance, as mentioned previously, should result in better forestry and more owner-control of cutting practices. Convincing the operators of concentration yards and planing mills that good forest practice by their contributing sawmills will ultimately benefit all concerned offers another solution. The producers of 40 percent of the lumber could be reached through only 30 of the largest concentration yards and lumber companies. One of the most effective ways would be public regulation of cutting practices. If found practicable this method would prevent deterioration of the forest, would protect the land owner, would assure a more stable supply of saw timber for industrial use, and would reduce resource competition between forest products industries.

Low-grade hardwoods: A high proportion of the hardwood volume in the Piedmont consists of inferior species and small, poorly-formed trees of the preferred species. Furthermore, the volume of this low-grade material is constantly increasing because the forest industries concentrate their drain upon pine and upon the best-quality oak and yellowpoplar.

Industrial product research is needed to develop new and large-scale uses for these low-grade hardwoods. Part of this research should be done at the Forest Products Laboratory of the Forest Service and part by commercial operators. The Laboratory is well equipped to develop products of wood conversion while local forest industrial plants should attempt to increase the variety of products manufactured from wood in its natural form.

Greater progress in the utilization of hardwoods might result if centralized plants were established to manufacture a variety of hardwood products. Dimension stock, handles, skis, shuttles, picker sticks, spools, buttons, cooperage, wooden dishes, and similar items could be produced in one plant with economies in manufacturing costs, with better utilization of grades and species, and with greater refinement of the product. Having more financial resources, better equipment, and more direct access to markets than do single-product mills these centralized plants should be in a better position to expand the use of all grades of hardwood.

Marketing of forest products: Most of the timber used by the forest industries in the Piedmont is obtained from farm woodlands and is purchased delivered at the mill or as standing timber. Very little material is sold by grade, although the veneer industry recognizes two classes of veneer blocks. Wood delivered at the plants is sold at a price established by the mill operator. The farmers have little bargaining power and usually must accept the price offered. The portable mills usually buy standing timber for a lump sum, a method which often places the farmer at a disadvantage because of his ignorance of timber volumes and values. This method also contributes to the deterioration of farm woodlands because the portable mills generally cut trees as small as 6 or 8 inches in diameter.

The farmers cannot grow timber on a sound basis under such marketing conditions. County foresters could effect some improvement by giving advice in timber estimating, cutting methods, log grading, timber values, and market opportunities. Improvement is also possible through the formation of cooperative marketing associations for the systematic sale of farm forest products. The purpose of cooperative action should be better management of forest land, better prices by offering graded material in bulk lots, protection to the small producer, and lower costs of distribution. These cooperatives should not attempt to be price-fixing associations nor should they necessarily eliminate the private middlemen such as the concentration yard operators. There is opportunity for the harmonious integration of forest cooperative activities with private mill operations for mutual benefit, but in case this fails the cooperatives should process their forest products in their own plants. Because cooperatives are simple in theory but rather complex in practice they should, at their inception, receive the advice and leadership of publicly employed foresters.

REVIEW OF THE REPORT

The Piedmont of North Carolina has a diversified economy. It leads the nation in the production of textiles and cigarettes and is the center of furniture manufacture in the South. Agriculture is important and extensive as the products from the 120,000 farms were valued at 85 million dollars in 1937. About one-half of the Piedmont is forested and no equal area in the South contains so many wood-using plants.

The forests, which occupy nearly five million acres, are 85 percent in farm ownership. Shortleaf pine is the most abundant species, making up two-fifths of the total cubic-foot volume. Pine types occupy 72 percent of the forest area, upland hardwoods 24 percent, and bottom-land hardwoods only 4 percent. About 90 percent of the forest is second growth. Slightly over one-half of the forest land supports sawlog-size stands, the remainder is stocked with young second growth.

The total saw-timber volume is 11 billion board feet, about seven-tenths pine and three-tenths hardwood. There are 72.5 million standard cords of wood with bark or 4.8 billion cubic feet of wood only.

Increment amounted to 709 million board feet, 3.3 million cords, or 222 million cubic feet. The average annual increment per acre was 149 board feet of saw timber, or seven-tenths of a cord of all sound material.

About 1,660 primary forest industrial plants operated in the Piedmont in 1937. There were 1,600 sawmills, 18 veneer plants, 18 furniture dimension plants, 6 handle plants, 7 shingle mills, 5 cooperage plants, 3 excelsior mills, 3 tobacco basket factories, and 2 shuttle block mills.

The sawmills used about 624 million board feet of sawlogs and the veneer plants about 27 million board feet. About 2.6 million cords of fuelwood were cut. The utilization of the forest resource provided 4-3/4 million man-days of employment divided among approximately 15,000 workers.

The total commodity drain was 886 million board feet of saw timber or 229 million cubic feet of all sound material. Drain upon the pine species exceeded increment by 184 million board feet but the hardwood increment exceeded drain by 7 million board feet. The total growing stock of the forest decreased by 8 million cubic feet.

The forest situation is not satisfactory in the Piedmont. The pine and better-quality hardwood timber is being cut faster than it is growing and the quantity of low-grade hardwood is increasing. Portable sawmills dominate the lumber industry and their cutting practices are detrimental to the future productivity of the forest. Measures for improvement should include adjustments in land use, more intensive fire protection, better forest management practices, a more intensive farm forestry program, greater control of small mill cutting practices, more efficient utilization of low-grade hardwoods, and cooperative action in marketing forest products.

The wide-spread adoption of these measures will assure a greater and more valuable forest resource on a permanent basis, and will create added security and opportunity for both the people and the forest industries of the Piedmont.

GLOSSARY

General

Forest Survey Unit. -- The term "forest survey unit" denotes an area of 4 to 10 million acres in which topographic, forest, economic, and industrial conditions are reasonably homogeneous.

Land-use Classes

Productive forest area. -- Forest land having qualities essential for the growth of commercial timber.

Nonproductive forest area. -- Forest land lacking qualities essential for the growth of commercial timber.

Cropland, old and new. -- Land used for production of farm or orchard crops or evidently so used during the past 5 years. This includes new cropland, i.e., land converted from forest to cropland within 5 years prior to survey.

Pasture. -- Cleared or open land under fence used primarily for grazing.

Abandoned cropland. -- Land once cultivated but showing distinct evidence of having been abandoned for agricultural crop production.

Other non-forest. -- Areas included within the corporate limits and surburban or industrial sections of cities and communities; power, rail, and highway rights-of-way; marsh; and nonmeandered waterways.

Forest Types

Shortleaf pine-hardwoods. -- Stands in which pines make up 25 percent or more of the dominant and codominant stems with shortleaf pine predominating.

Loblolly pine-hardwoods. -- Stands in which pines make up 25 percent or more of the dominant and codominant stems with loblolly pine predominating.

Virginia pine-hardwoods. -- Stands in which pines make up 25 percent or more of the dominant and codominant stems with Virginia pine predominating.

Upland hardwoods. -- Stands in which mixed oaks and other hardwoods make up 75 percent or more of the dominant and codominant stems, usually found on the rolling upland sites.

Bottom-land hardwoods. -- Stands in which hardwoods make up 75 percent or more of the dominant and codominant stems, usually found in river bottoms and swamps.

Diameters

D.b.h. (diameter at breast height). -- Diameter, outside of bark, measured at $4\frac{1}{2}$ feet from the ground.

Diameter class. -- All trees were recorded in 2-inch diameter classes, including diameters 1.0 inch below and 0.9 above the stated midpoint, e.g., trees 7.0 to 8.9 inches d.b.h. are placed in the 8-inch class.

Tree Classification

Sound sawlog-size tree. -- A pine, cypress, or redcedar tree at least 9.0 inches d.b.h., or a hardwood tree at least 13.0 inches d.b.h., with not less than one sound butt log 12 feet long, or with 50 percent of the gross volume of the tree in sound saw timber.

Sound under-sawlog-size tree. -- Any tree over 1.0 inch d.b.h. and less than sawlog-size, with a reasonably straight sound stem.

Cull tree. -- Any tree that fails to qualify as a sound sawlog or under-sawlog-size tree because of form, limbiness, rot, or other defect.

Pole tree. -- Pine trees that will produce a pole conforming to specifications of the American Standards Association.

Forest Conditions

Sawlog Size

Old growth, uncut. -- Stands composed of trees having the characteristics of the original mature timber of the region and containing at least 1,000 board feet per acre of merchantable species in hardwood types, and 600 board feet per acre in pine types, with less than 10 percent of the volume cut.

Old growth, partly cut. -- Old-growth stands from which 10 percent or more of the volume has been cut, leaving a minimum of 1,000 board feet per acre in the hardwood types, or 600 board feet per acre in the pine types.

Second growth, uncut. -- Stands of second growth having at least 600 board feet per acre in trees of sawlog-size, and with less than 10 percent of the sawlog-size trees removed.

Second growth, partly cut. -- Stands of second growth from which 10 percent or more of the sawlog-size trees have been removed but with the remaining stand containing 600 or more board feet per acre.

Under Sawlog Size

Second growth. -- Young second-growth stands in which the volume of timber in trees of sawlog size is less than 600 board feet per acre and the remainder of the trees are below sawlog size.

Reproduction. -- Stands too young to classify as second growth having at least 80 well distributed seedlings per acre.

Clear-cut. -- Cut-over areas having insufficient young growth to qualify either as second growth or reproduction.

Volume Estimates

Board-foot volume. -- Only the saw-timber portion of sawlog-size trees are included in this estimate. Top diameters vary with the limits of usable material. Deductions are made for woods cull and for loss in sawing at the mill.

Cordwood volume. -- This volume (including bark) is derived from the following sources:

1. The sawlog portion of sawlog-size trees.
2. The portion of saw-timber trees not usable as sawlogs but acceptable as cordwood. This includes the upper stems of pine and cedar and, unless otherwise noted, the upper stems and limbs of hardwoods and cypress. The minimum diameter limit is 4.0 inches outside bark.
3. The full stem of sound under-sawlog-size trees, at least 5.0 inches d.b.h., to a variable top diameter not less than 4.0 inches outside bark.
4. The estimated sound material in cull trees.

Deductions for cull include only the volume in defects which cause the material to be unsuited for cordwood. Sweep and slight crook are not regarded as defects.

Cubic-foot volume. -- This volume is derived from the same sources as the cordwood volume except that bark is not included.

Standard cord. -- A stacked pile of round or split wood bolts measuring 4' x 4' x 8' and estimated to contain 90 cubic feet of wood and bark in the pine, cedar, and cypress species, and 80 cubic feet of wood and bark in the hardwood species.

Increment

Growing stock. -- The sum of the volumes of all sound trees 5.0 inches d.b.h. and larger; dead and cull trees and tops of hardwood and cypress not included.

Board-foot increment. -- Includes the net growth on the saw-timber portion of sawlog-size trees, plus the volume in sound trees reaching sawlog-size.

Cordwood increment. -- Includes the net growth on the sound stemwood of pines and cedar 5.0 inches d.b.h. and over, on under sawlog-size hardwoods and cypress, and on the sawlog portion of sawlog-size hardwoods and cypress, plus the sound-tree volume of all species reaching 5.0 inches d.b.h. during the increment period.

Cubic-foot increment. -- Omits bark volumes, otherwise material is identical with cordwood.

Mortality

Mortality. -- The volume lost from the growing stock of the forest through the death of individual trees. Natural causes of mortality include lightning, tree competition, old age, disease, insects, drought, and wind. Fire is the major man-caused source of mortality.

Site Index

Site index. -- The average height attained by dominant and codominant trees at 50 years of age.

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FOREST SURVEY RELEASE NO. 7 APRIL 1, 1941

FOREST RESOURCES OF THE MOUNTAIN REGION OF NORTH CAROLINA

by

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Associate Forest Economist

A FOREST SURVEY PROGRESS REPORT

E. V. Roberts, Regional Survey Director

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

Appalachian Forest Experiment Station
R. E. McArdle, Director
Asheville, N. C.

PREFACE

Through the McSweeny-McNary Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act, and each of the 12 Regional Experiment Stations is responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station, Asheville, North Carolina.

The work of the Survey is divided into 5 major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of the timber on these lands.

2. Growth. Determination of the current rate of timber growth.

3. Drain. Determination of the amount of industrial and domestic wood use, and the total loss from fire, insects, disease, suppression, and other causes.

4. Requirements. Determination of the current and probable future requirements for forest products, by all classes of consumers.

5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis for public and private policies and plans of forest land use and management.

This progress report presents preliminary information on the first three of these phases for the Mountain Region of North Carolina, the last of the four units into which the state was divided. A similar release has been published for each of the Coastal Plain Units and for the Piedmont Region.

Information on the physical forest resources was obtained by a field survey made in the summer of 1938. A total of 6,614 sample plots was established at intervals of one-eighth of a mile on compass lines 10 miles apart, extending across the unit in a northwest direction. The statistical sample obtained from these plot records forms the basis for all area and volume estimates in this report, except where other sources are directly credited. Owing to the method of sampling, small tabular items have the greater probability of error and should be considered as indicating relative magnitude rather than actual values.

Data on consumption of forest products for industrial and domestic purposes were obtained by canvassing all primary manufacturing plants and a number of representative domestic consumers.

Forest Survey Staff
Assisting in the Preparation of this Report

Compilation and analysis of inventory, growth and drain data	G. E. Morrill, In charge T. C. Evans

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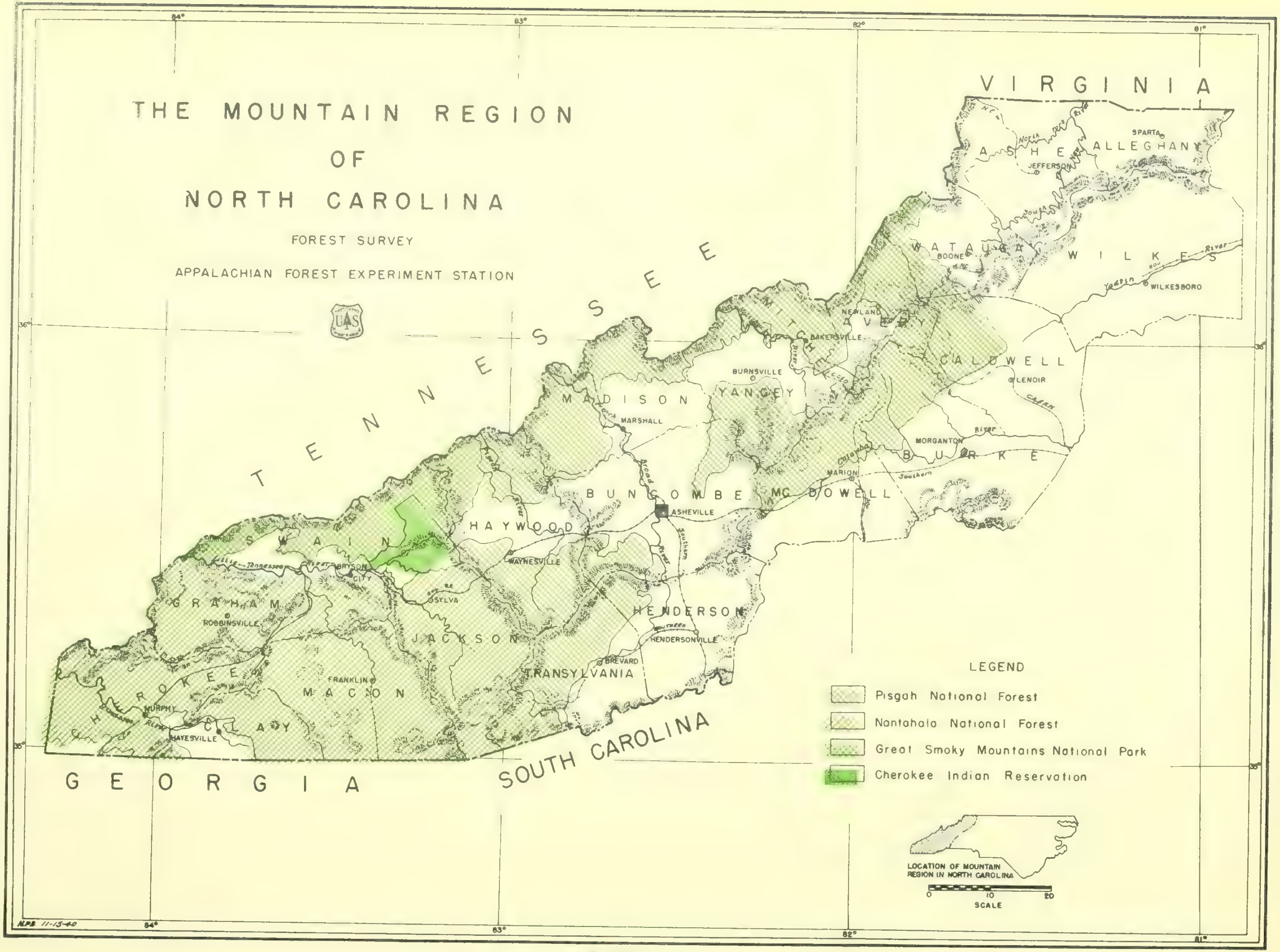
THE MOUNTAIN REGION
OF
NORTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
VIRGINIA
TENNESSEE
GEORGIA
SOUTH CAROLINA
ASHE
ALLEGHANY
WATAUGA
WILKES
AVERY
MITCHELL
CALDWELL
YANCEY
MADISON
BURKE
MC DOWELL
BUNCOMBE
HAYWOOD
SWAIN
GRAHAM
CHEROKEE
CLAY
MACON
JACKSON
TRANSYLVANIA
HENDERSON
SPARTA
JEFFERSON
BOONE
WILKESBORO
NEWLAND
BAKERSVILLE
BURNSVILLE
LENOIR
MORGANTON
MARION
MARSHALL
ASHEVILLE
WAYNESVILLE
BRYSON CITY
SYLVA
ROBBINSVILLE
FRANKLIN
MURPHY
HAYESVILLE
BREVARD
HENDERSONVILLE
LEGEND
Pisgah National Forest
Nantahala National Forest
Great Smoky Mountains National Park
Cherokee Indian Reservation
LOCATION OF MOUNTAIN REGION IN NORTH CAROLINA
0
10
20
SCALE
84°
83°
82°
81°
36°
35°
NPB 11-15-40

FIGURE I

FOREST RESOURCES OF THE MOUNTAIN REGION OF NORTH CAROLINA

INTRODUCTION

Forests constitute one of the most important natural resources of the mountain region of North Carolina. They are essential to the valuable tourist and recreation industry, they aid in the control of streamflow and erosion, they furnish food and shelter to game, and they provide raw material for personal and industrial uses, a function highly important in a region where incomes and opportunities for employment are inadequate to meet the needs of local people.

Effective use of this resource is difficult without up-to-date and comprehensive information regarding the existing forest, its deficiencies, limitations, and possibilities. Such information is presented by means of a brief sketch of the physical, social, and industrial conditions within the area, a detailed description of the forest and forest industries, and an analysis of the forest problems.

PHYSICAL CHARACTERISTICS OF THE UNIT

The mountain region of North Carolina, Forest Survey Unit 4, embraces 21 counties located west of the Piedmont Plateau (figure 1). The total area involved is 5,623,000 acres, nearly one-fifth the area of the State.

Physiographically, the mountains of North Carolina are included in the Blue Ridge division of the Southern Appalachians. In Virginia the Blue Ridge is narrow, but in North Carolina it widens out to form a high plateau, broken by mountain masses and river basins, extending from the Piedmont of North Carolina on the east to Tennessee on the west. The eastern edge is bounded by an irregular chain of mountains known as the Blue Ridge, which extends across the state from northeast to southwest. Viewed from the Piedmont this chain presents a steep and rugged escarpment 2,000 to 3,000 feet high. The plateau is enclosed on the west by the Iron, Great Smoky, and Unaka Mountains, which form the boundary between North Carolina and Tennessee.

Between the eastern and western mountain boundaries there are a number of cross ranges that divide the plateau into smaller plateaus or basins, each having its own drainage system. Among these mountain ranges are the Black Mountains; Mt. Mitchell, one of the peaks of this range, rises to an altitude of 6,684 feet, the highest peak east of the Mississippi River. Other cross ranges are the New Found and Pisgah Mountains, the Balsam Mountains, the Cowee Mountains, and the double chain of the Nantahala and Valley River Mountains.

In western North Carolina the Appalachian Mountains Reach their climax. More than 40 peaks are over 6,000 feet in elevation and more than 80 exceed 5,000 feet. Forests extend to the tops of most of the mountains, although on some of the higher elevations the trees give way to mountain meadows, locally known as "balds".

Between the high mountain ranges are fertile valleys. Along the larger streams the valley bottoms are frequently wide and level, well suited for successful farming, but along the smaller creeks tillable land is often at a premium. Practically all of the streams, both large and small, originate high up on the mountain slopes, usually between two spurs or ridges. These secluded mountain valleys are called "coves" and are much prized because of ther fertility.

Drainage from the mountain region goes to both the Atlantic Ocean and the Gulf of Mexico. The Yadkin, Catawba, and Broad Rivers drain the eastern slopes of the Blue Ridge Mountains while the main body of the region is drained westward by the New, Watauga, Nolichucky, French Broad, Little Tennessee, and Hiwassee Rivers with their numerous tributaries. Many of the mountain streams are important sources of hydro-electric power as well as of municipal water supplies, and watershed protection through the maintenance of a forest cover on the steep slopes is a regional necessity.

A high proportion of the soils are classified in the Porter series which includes some of the best soils of the mountain region. With suitable crop rotations most of the soils on the more level lands are very productive. A large part of the mountain land is too rough and stony for agricultural use but many of the gaps and smooth ridges provide excellent pasturage. Much of the land is also too steep for profitable cultivation, and the control of erosion is an ever-present problem. Practically all of the different soils, except those on the exposed ridge-tops, are suitable for timber production and the limitations imposed upon agriculture by soil and topography have allowed two-thirds of the land to remain under a forest cover.

SOCIAL AND ECONOMIC CONDITIONS

Within this region the population exceeds the developed economic opportunity. The scarcity of tillable land, poor farming methods, and lack of markets have resulted in a very low farm income and forest employment has decreased with the depletion of the timber. A high rate of population increase has further aggravated the situation. At present the people are supported by agriculture, timber utilization, manufacturing, the tourist trade, and scattered mines of only local importance. The need for greater development of these economic foundations is obvious when it is realized that about one person in 6 was on relief in 1933-34.

People

The population of the mountain region has increased from 295,000 in 1900 to 520,000 in 1940. The birth rate is extremely high, about 50 percent greater than for the United States as a whole.[1] Since the resources of the region are not sufficient to support such a rapidly increasing population some of the more progressive individuals emigrate to other sections.

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[1] U. S. Dept. of Commerce, Bureau of the Census, 1930.

With the advent of the depression in the early 30's many of those who had migrated to outside industrial areas returned to the mountain farms and the farm population increased from 241,000 to 285,000 in the five years between 1930 and 1935.

In 1935 about 138,000 persons were employed in farming, business, and industry. Seventy percent of these were engaged in agriculture, 21 percent in manufacturing, 5 percent in retailing, and 4 percent in miscellaneous activities including wholesale trade and the service industries. Approximately 20 percent of all the people live in urban centers of more than 2,500 inhabitants. Asheville is the largest city of the region but Canton, Hendersonville, Morganton, Lenoir, Mt. Airy, and North Wilkesboro are active industrial or tourist centers. About 80 percent of the total population is rural, two-thirds living on farms and in small villages.

Population density has a direct influence upon land-use practices and size of land holdings, both factors that affect agrarian incomes. The distribution of the rural population in this area is modified primarily by topography. The extremely rough and mountainous country is usually without resident population. The people tend to concentrate in the valleys or on the plateaus because the land is more level and fertile for farming, transportation facilities are better and more accessible, and opportunities for industrial employment are more conveniently available. There has been a marked influx of people into the valley areas dominated by Marion, Asheville, Canton, Waynesville, and Sylva. This is due partly to industrial and agricultural advantages and partly to the development of this portion of the Blue Ridge as a recreational center. Other areas of dense population; for example, those in Ashe, Avery, Mitchell, and Yancey Counties, are less an indication of economic opportunity than of overcrowding on the available arable land.

In Yancey County 70 percent of the farmers live on farms averaging only 19 acres in size. In 1935 the average gross value of crops per farm of all farms in the county was only $200 and only a small part of this crop value was converted into cash income. Obviously it is impossible to maintain a satisfactory standard of living on such small acreages without additional income.

Agriculture

According to the 1935 Census of Agriculture, farms occupied 59 percent of the land in the unit. A total of 55,600 farms contained 3,308,000 acres, half of which were woodland. Most farms in the mountain sections were small, with only a few acres in cultivation, and those with extensive cultivatable acreages were restricted almost entirely to the larger river valleys. Sixty percent of the farms contained less than 50 acres and 83 percent contained less than 100 acres. The average farm consisted of 59 acres, of which 14 were cropland, 12 were open pasture, 3 were in miscellaneous uses, and 30 were woodland. The average value of land and buildings in 1935 was $1,665 per farm compared to the state average of $2,069 and the national average of $4,823. The farms of Graham County had the exceptionally low average value of only $752 while those of Henderson County, valued at $2,671, exceeded the state average. In general, farm values are low because most of the farms are small, with poor buildings, of steep, mountainous topography, isolated from markets. Transportation facilities have been improved since 1930 but at that time 56 percent of the farms were reached by unimproved dirt roads[1].

Directly associated with low farm values are low farm incomes. In 1929 the gross farm income per farm inhabitant was less than $100 in one-half of the counties in the unit.[2] Only in Haywood and Allegheny Counties did the gross farm income exceed $150 per capita. Since these values include the produce consumed on the farms it is obvious that the cash income per rural inhabitant was meager even before the depression.

In 1935 the value of farm products was approximately 19.5 million dollars, an average of $350 per farm compared to the state average of about $975 per farm. Cultivated crops had a total value of 12.5 million dollars, with corn accounting for 5 million and tame hay for 1.5 million. Tobacco and Irish potatoes were the important cash crops but the value of these two commodities was only 2.5 million dollars in 1935. Farms in Buncombe, Ashe, Haywood, and Wilkes Counties produced a large proportion of the meat animals which were valued at 6.5 million dollars. Forest products sold on about 15 percent of the farms contributed nearly $600,000 to the farm income in 1934.

Manufacturing

Approximately 28,000 people were occupied in the manufacturing industries in 1935, according to the Bureau of the Census. Textile mills employed about 14,000, furniture plants about 5,000, primary wood-using plants about 7,000, leather factories about 1,000, and mines and mineral plants about 1,000. Altogether they received 23 million dollars in wages and made products valued at about 80 million dollars.

Most of the textile and furniture plants are located in Wilkes, Caldwell, Burke, and McDowell Counties, east of the Blue Ridge Mountains (figure 2). Because of the mountain barrier these plants are more a part of the economic life of the Piedmont than of the true mountain region. West of the Blue Ridge Mountains the major industrial area lies in a narrow belt between Asheville and Waynesville, in Buncombe and Haywood Counties. The rayon mill at Enka, near Asheville, is the largest manufactory in the unit from the standpoint of employment provided and the pulp and paper mill at Canton is nearly as large. These two plants and the blanket factory at Swannanoa, just east of Asheville, provide about one-fifth of the total industrial employment in the unit. Other noteworthy industrial developments include the textile mills in Henderson County which employ about 1,000 people and the new cigarette paper mill near Brevard employing about the same number. Three-fifths of the people in the unit live in the 8 counties in which the industrial plants are concentrated, the remaining two-fifths are distributed throughout 13 counties and are largely dependent upon agriculture, timber, and the tourist trade for an income.

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[2] U. S. Department of Commerce, Bureau of the Census, 1930.

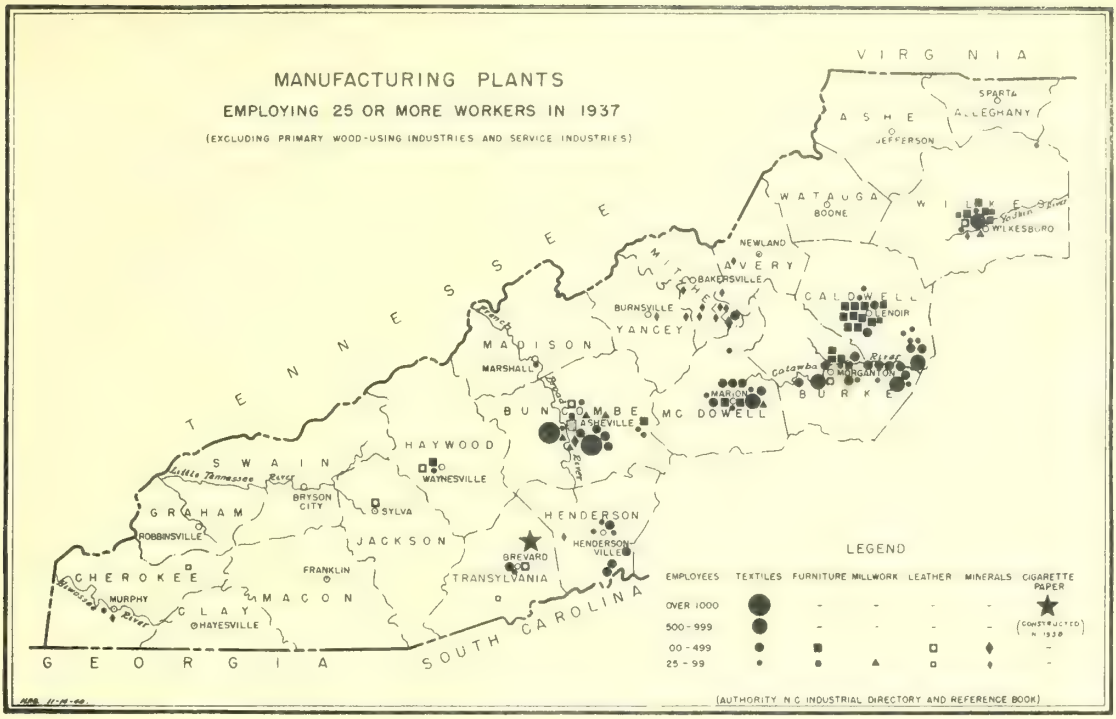


FIGURE 2

Power

The mountain streams of this region have been used for power since the time of the first settlers. Even today water-powered grist mills are a common sight in the rural communities. A few small sawmills are also powered directly by water. These neighborhood industries are relatively unimportant users of the power potentialities of the numerous streams, however, and it was only with the development of hydro-electric plants after 1900 that the electric power became generally available for industrial and domestic use. At present there are about 25 hydro-electric plants with a total capacity of approximately 400,000 horsepower. Five power companies operate hydro-electric stations and distribution systems, and the Aluminum Company of America develops electrical energy at the Cheoah and Santeetlah power dams in Graham County. The largest hydro-electric installation, of 145,000 horsepower, is at Waterville on the Pigeon River in Haywood County. It is owned by the Carolina Power and Light Company and develops the electric energy used in the territory surrounding Asheville. The newest large completed development is the Hiwassee Dam constructed by the Tennessee Valley Authority on the Hiwassee River about 20 miles downstream from Murphy in Cherokee County. Operation for power is scheduled to begin in 1941. The Aluminum Company of America also started construction of the Glenville and Nantahala Dams in the fall of 1940. The power developed at these dams will probably be used in the manufacture of aluminum for national defense.

Taxation

The real and personal property in the mountain region was assessed at 294 million dollars in 1937, an amount equal to 12.5 percent of all such property in the State. Buncombe County contained almost one-third of all the property value in the unit. County tax rates varied from 90 cents in Allegheny and Burke Counties to $2.50 in Clay County. Taxes assessed by the counties amounted to 3.4 million dollars. Forest land makes up an appreciable part of the tax base in some counties, a rather minor proportion in others. In Macon County forest land and timber accounted for nearly 20 percent of the value of all real and personal property; in Buncombe County for only 3 percent. The low ratio in Buncombe County is due to the important urban and industrial values, however, because the assessed value of forest land was more than twice that of Macon County. In general, it is estimated forest land and timber account for about 10 percent of the tax base.

Forest land is usually allocated by tax assessors into four classes for taxation purposes: waste land, cutover land, woodland, and timberland. Among the counties there is a rather wide range of assessed values placed upon land in similar categories. Studies made in 1937 in Buncombe, Caldwell, Haywood, Macon, and Transylvania Counties show that woodland was assessed at $9.76 per acre in Macon County and at $20.42 in Buncombe County. Assessed value of timberland varied from $8.27 in Transylvania County to $29.40 in Buncombe County.3/ Taxes per acre varied from 4.1 to 14.2 cents on waste land, 7.5 to 8.0 cents on cutover land, 12.7 to 19.6 cents on woodland, and 13.4 to 28.2 cents on timberland. The total taxes levied against forest land and timber in the five counties amounted to nearly 30 percent of the rural real estate taxes in those counties.

Land Ownership

Almost one-third of the forest land is in public ownership (table 1). The Nantahala and Pisgah National Forests contain 771,000 acres, including an area of 16,500 acres around Hiwassee Lake recently transferred from the Tennessee Valley Authority to the Forest Service. Much of the more rugged and less accessible land in 15 counties is in National Forests. Most of the Cherokee Indian Reservation is in Swain and Jackson Counties near Cherokee. Other smaller tracts are located in Haywood, Graham, Cherokee, and Macon Counties. The Great Smoky Mountains National Park in North Carolina occupies the eastern slopes of the Great Smoky Mountains in Swain and Haywood Counties. The Blue Ridge Parkway, an elongated park with a scenic motorway, enters the state from the northeast about 20 miles west of Mt. Airy and proceeds southwest along the ridgetops to the Great Smoky Mountains National Park. In most cases the right-of-way is 200 to 300 feet wide although overlooks are wider and parks contain up to 5,400 acres. The State purchased the Mt. Mitchell State Park in Yancey County and it has established the Rendezvous Mountain State Park on privately donated land in Wilkes County. The municipal watersheds belong to cities and towns in Buncombe, Cherokee, Haywood, Jackson, Madison, Swain, and Transylvania Counties. The largest watershed, about 23,000 acres, is owned by the city of Asheville.

3/Nelson, R. W., Taxation of forest property in North Carolina, Forest Taxation Inquiry, U. S. Forest Service, 1938.

By far the largest proportion of the forest land is owned by farmers. As a rule the farm woodlands consist of small tracts, distributed among many of the farms. Most of the industrial owners are lumber companies, although two paper companies own several thousand acres. Investment owners consist of non-operating mining and lumber companies, clubs and associations, recreational development companies, and private owners holding land for speculation. Lumber companies have the largest acreages. Power companies own approximately 100,000 acres around Lake James, Rhodhiss Lake, Waterville Lake, Cheoah Lake, and Lake Santeetlah. The 20,000 acres of hunting preserves are located near Asheville and Lake Toxaway. It is probable that other hunting preserves are included in the 561,400 acres for which no ownership record was obtained.

Table 1. - Ownership of forest land, 1939

Ownership	Distribution of forest area	
	Acres	Percent
Public:		
Nantahala National Forest	331,100	8.6
Pisgah National Forest	439,900	11.5
Cherokee Indian Reservation	53,000	1.4
Great Smoky Mountains National Park	229,800	6.0
Blue Ridge Parkway	21,900	0.6
Mt. Mitchell & Rendezvous Mountain State Parks	1,400	Negl.
Municipal Watersheds	40,200	1.1
Total public	1,117,300	29.2
Private:		
Farm woodlands*	1,670,600	43.7
Industrial owners	200,400	5.2
Investment owners	156,900	4.1
Power companies	100,000	2.6
Hunting preserves	20,000	0.5
All other	561,400	14.7
Total private	2,709,300	70.8
Total all forest land	3,826,600	100.0

*1935 Census of Agriculture.

Land Use

The use of land affects nearly every phase of community life. This is especially true in the mountain region with its large rural population. About two-thirds of the land is forested but not all of this is used primarily for timber production. The wooded mountains of the Great Smoky Mountains National Park are dedicated to recreational use and commercial timber sales are prohibited by law. The Nantahala and Pisgah National Forests combine commercial timber production with recreational use. Much of the land in these Forests was acquired in a cut-over condition and consequently many years will elapse before full productivity can be restored. In the meantime the recreational assets of the Forests are being developed, with immeasurable benefit to the vacationing public and with concrete financial returns to the adjoining local communities. It is estimated that Buncombe County, in which Asheville is located, obtains 10 million dollars annually from the tourist trade.

The wooded mountain slopes are valuable also for water control and storage. The Pisgah National Forest provides water for six local towns and for the large new plant of the Ecusta Paper Corporation at Brevard. One of the more important factors influencing the location of this plant was the assurance of an adequate supply of pure water. In addition, the Champion Paper and Fibre Company at Canton and the Enka Corporation near Asheville obtain part of their water requirements from watersheds on the Pisgah National Forest. Protective strips of forest land are also maintained by power companies around the large reservoirs.

Most of the privately owned forest land is used primarily for timber production by lumber companies and farm owners. Some private forest land is used for recreation in the form of hunting and fishing clubs, private estates, and summer camps. One of the largest commercial concerns devoted to the recreational use of forest land is the Linville Development Company operating in the Grandfather Mountain section of Avery and Watauga Counties.

Figure 3 shows in a general way the areas in which specific kinds of forest land use are dominant. It should be recognized, however, that there are many local variations within any area and that recreation and water control are important uses of forest land throughout the region.

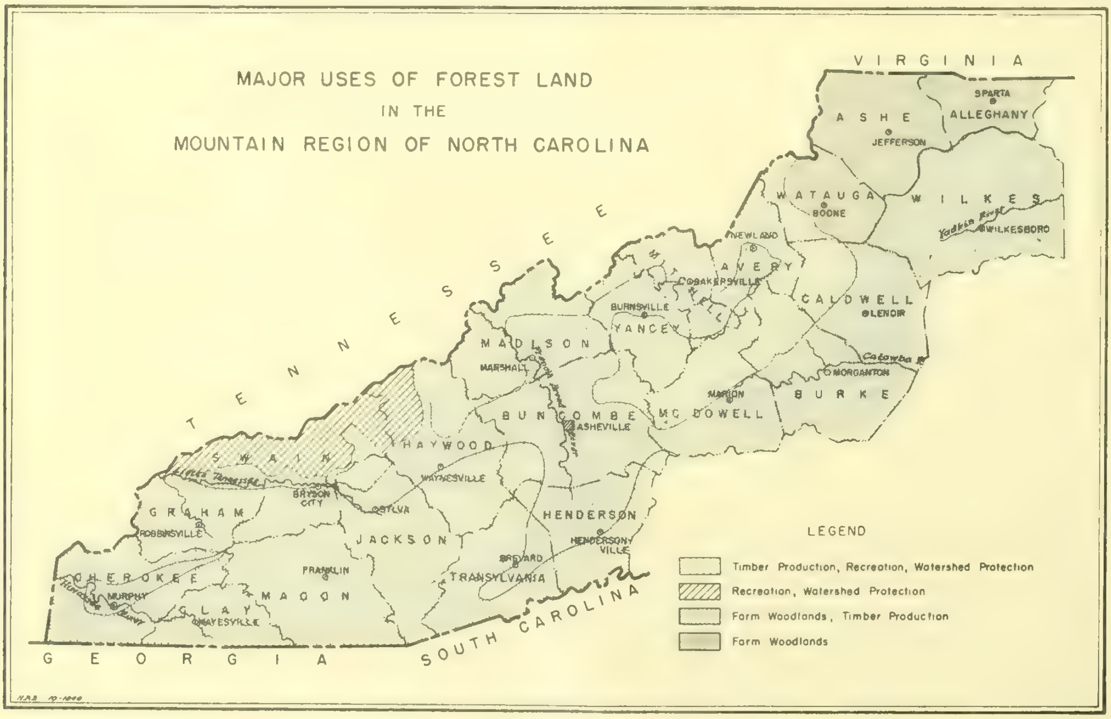


FIGURE 3

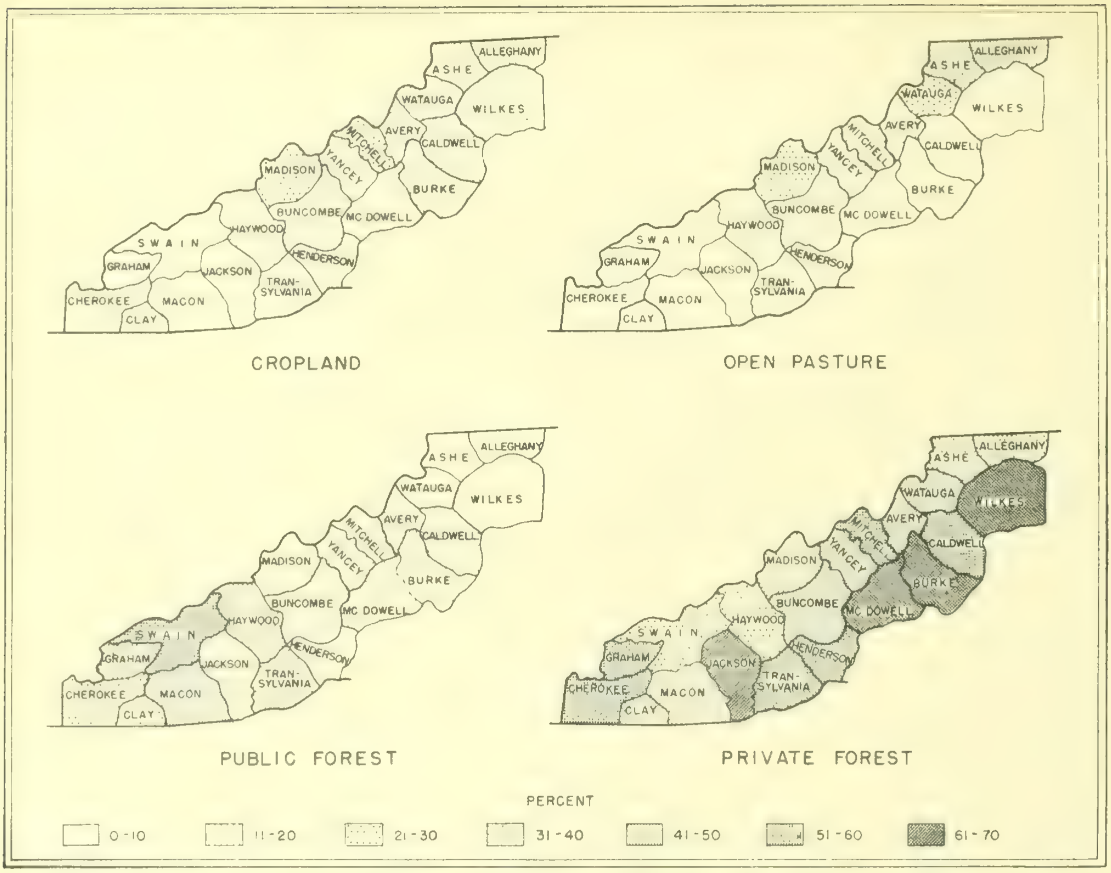
Basically, the land in this unit is used for cultivated crops, for grazing, and for forests. A small proportion, 3 percent, is used for townsites and rights-of-way, and an even smaller proportion, 2 percent, is abandoned cropland not in productive use. The non-productive forest land includes rock outcrops and dry ridges too infertile to produce timber of commercial quality. For the unit as a whole, only 17 percent of the land is used for farm crops, 11 percent is in pasture, and 67 percent is forested (table 2). The area within the Great Smoky Mountains National Park has been excluded from this table and will be omitted hereafter in all tables of area and volume, because the land and timber is withdrawn from commercial use.

Table 2. - Total land area classified according to major use, 1938*

Land-use	Area**	Proportion of total area
	Acres	Percent
Forest:		
Productive	3,543,800	65.7
Nonproductive	53,000	1.0
Total forest	3,596,800	66.7
Nonforest:		
Agriculture:		
Old cropland	896,100	16.6
New cropland	25,300	0.5
Pasture	596,100	11.1
Total agriculture	1,517,500	28.2
Abandoned cropland	120,700	2.2
Other nonforest	158,200	2.9
Total nonforest	1,796,400	33.3
Total area	5,393,200	100.0

*Does not include 229,800 acres in Great Smoky Mountains National Park.
**Based on Forest Survey data.

Land use varies considerably between counties (figure 4). Only a small proportion of the land within each county is used for cultivated crops, varying, according to the 1935 Census of Agriculture, from 5 percent in Swain County to 21 percent in Madison and Mitchell Counties. Open pasture land is most common in Ashe and Allegheny Counties where 41 percent of the land is used for grazing. Over half of the land in Swain County and more than 40 percent of that in Macon County is occupied by public forests. A larger proportion of the forest land is under private ownership in Burke, Jackson, McDowell, and Wilkes Counties than in Swain and Macon Counties where most of the forest land is in the Great Smoky Mountains National Park, the Cherokee Indian Reservation, and the Nantahala National Forest



CROPLAND

OPEN PASTURE

PUBLIC FOREST

PRIVATE FOREST

FIGURE 4.- PROPORTION OF COUNTY AREA DEVOTED TO VARIOUS KINDS OF LAND USE.

DESCRIPTION OF THE FOREST RESOURCE

The forests of the mountain region in North Carolina occupy 3.5 million acres, two-thirds of the total land area. A great variety of species are common to this region, Frothingham[4] lists about 60 that are used commercially. Hardwood species predominate, although eastern white, shortleaf, Virginia, pitch, and table mountain pines, eastern hemlock, red spruce and Fraser fir grow in certain localities. Combinations of species are complex and varied, representing the influence of cutting practices, chestnut blight, forest fires, species peculiarities, moisture conditions, topographic aspect, and elevation. The original mountain forests contained timber of high quality but now only a few scattered stands of old growth remain. Repeated cutting and forest fires have hindered the development of good-quality second growth and at present over one-half of the forest land is stocked with young stands below saw-timber size containing a high proportion of cull trees and low-quality species.

Species

There are at least 50 species of commercial hardwoods. The chestnut blight has killed practically all of the chestnut but even now nearly one-fourth of the sound cubic-foot volume in trees larger than 5.0 inches d.b.h. is standing chestnut still usable for extract wood or lumber. Yellowpoplar is probably the most valuable tree in the region. On moist sites, particularly in the coves, it grows rapidly and produces wood of good quality that is used for lumber, furniture, and veneer. It is abundant, readily salable, and comparatively easy to reproduce and manage.

The white oak growing in the coves is generally of excellent quality but on the drier ridges it is of little value. In coves and on ridges that are not too dry northern red oak produces good saw timber. Chestnut oak is abundant and is the best of the oaks growing on the drier sites. It is used for sawlogs and crossties and the bark is a source of tanning extract. The oaks in the red oak group (black, scarlet, and southern red) are of rather inferior quality although black oak may be a good timber tree on fertile soils. Scarlet oak often is culled because of heart-rot and excessive limbiness.

The hickories, shagbark, mockernut, pignut, and bitternut, are abundant, but as a group they are looked upon with disfavor by lumbermen because of shake and a predominance of red heartwood in the older trees. Young second-growth hickory on a good site makes rapid growth and is used for handles, ski stock, and other special products. Red maple is rather common, growing on practically all sites. It is used in the cheaper grades of furniture and for paper pulp. Basswood, almost as valuable as yellowpoplar, grows with it in the coves. Black locust is found on all sites except at the highest elevations. Sugar maple, black cherry, ash, and black walnut are valuable species but of infrequent occurrence. One of the best stands

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[4] Frothingham, E. H., 1931. Timber growing and logging practice in the Southern Appalachian Region. U. S. Dept. Agr. Tech. Bul. 250. 93 p. illus.

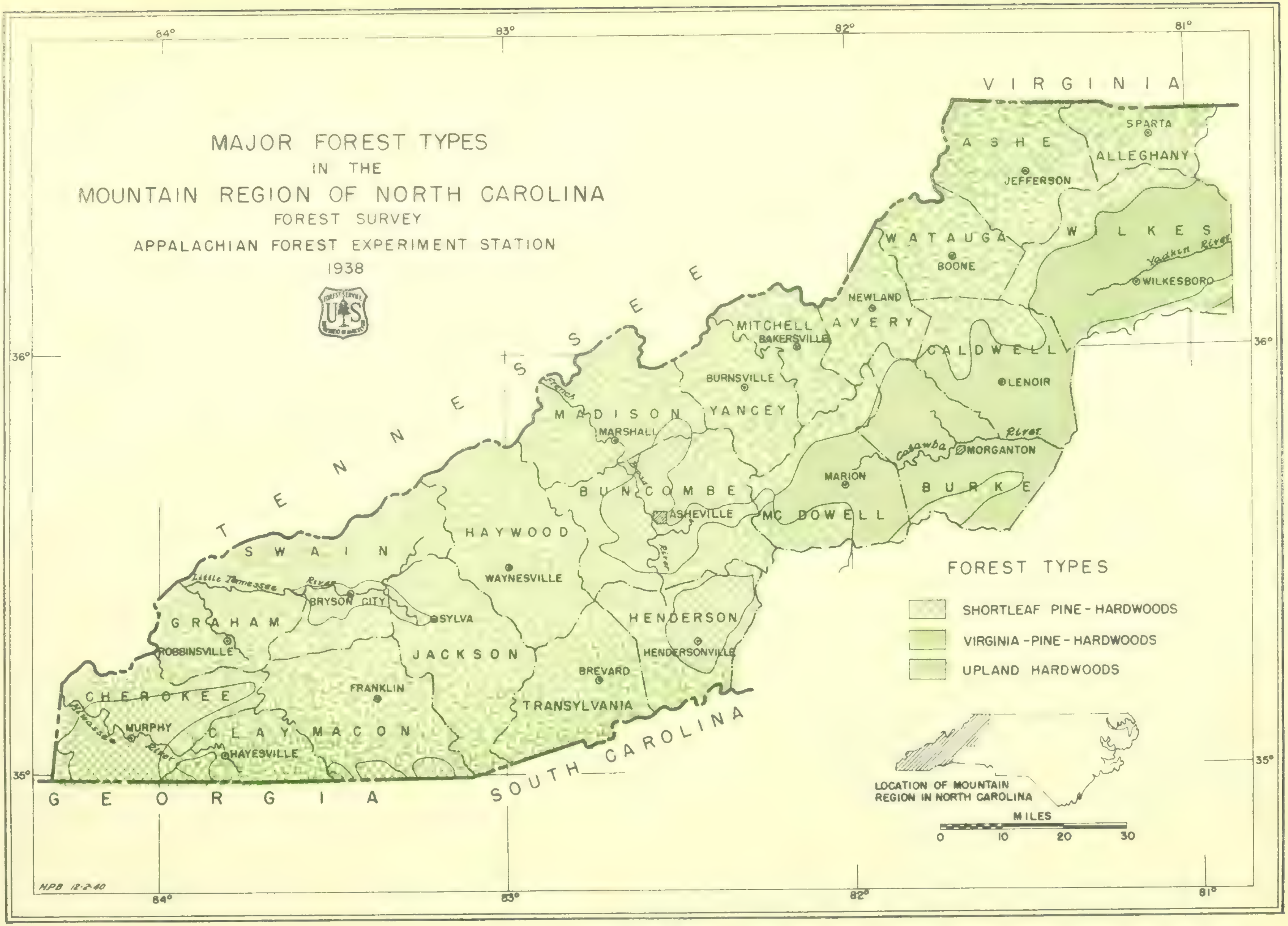
MAJOR FOREST TYPES
IN THE
MOUNTAIN REGION OF NORTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1938
VIRGINIA
TENNESSEE
GEORGIA
SOUTH CAROLINA
ASHE
ALLEGHANY
SPARTA
JEFFERSON
WATAUGA
BOONE
WILKES
WILKESBORO
Yadkin River
AVERY
NEWLAND
MITCHELL
BAKERSVILLE
CALDWELL
LENOIR
YANCEY
BURNSVILLE
MADISON
MARSHALL
French
BUNCOMBE
ASHEVILLE
River
MC DOWELL
MARION
BURKE
MORGANTON
Catawba River
HAYWOOD
WAYNESVILLE
SWAIN
BRYSON CITY
Little Tennessee River
SYLVA
JACKSON
HENDERSON
HENDERSONVILLE
TRANSYLVANIA
BREVARD
GRAHAM
ROBBINSVILLE
CHEROKEE
MURPHY
Hiwassee River
CLAY
HAYESVILLE
MACON
FRANKLIN
FOREST TYPES
SHORTLEAF PINE - HARDWOODS
VIRGINIA - PINE - HARDWOODS
UPLAND HARDWOODS
LOCATION OF MOUNTAIN REGION IN NORTH CAROLINA
MILES
0
10
20
30
84°
83°
82°
81°
36°
35°
HPB 12-2-40

FIGURE 5

of old-growth sugar maple is along Big Ivey Creek in Buncombe County. Many other hardwood species grow in the mountain region but they have not been discussed because of their scarcity or low commercial value.

Shortleaf pine is the most important softwood species on the lower slopes and plateaus. It is common in the Asheville Basin, in Henderson and Cherokee Counties, and in the foothills of the Blue Ridge Mountains in association with Virginia pine. Pitch and table mountain pine occur on the upper south and west slopes of the mountains. On poor sites they are inferior trees but on good sites pitch pine is often equal in quality to shortleaf pine. Eastern white pine is irregularly distributed throughout the unit but is most abundant in Caldwell and Wilkes Counties. It grows on both the higher slopes and in the valleys, wherever it is not too dry and windy. Eastern hemlock is less abundant than eastern white pine. Although extremely tolerant of shade it prefers moist fertile soil and the cool, humid climate of north slopes and coves. Red spruce is associated with Fraser fir (southern balsam fir) at the highest elevations. Most of the remaining spruce-fir forest is in the Great Smoky Mountains National Park but scattered stands occur in the Pisgah National Forest and the Asheville municipal watershed.

Forest Types

In the field survey the forest stands were classified into 16 forest types but for the purpose of concise presentation they have been combined into five; upland hardwoods, cove hardwoods, shortleaf pine-hardwoods, white pine-hardwoods, and Virginia pine-hardwoods. The relatively small area in the cove hardwoods and white pine-hardwoods types are not shown in figure 5, neither are the areas of included agricultural land.

The upland hardwoods type is most prevalent, occupying 60 percent of the forest land (table 4). It includes the forests growing on the dry slopes and ridges facing south and west and also the forests on the north and east slopes not included in the cove hardwoods type. Nearly two-thirds of the land in the upland hardwoods type contains considerable dead chestnut in mixture with various species of oak. Topographic aspect does not greatly influence the distribution of species but the south and west slopes are least productive. Compared with the cove hardwoods this type contains a smaller proportion of yellowpoplar, basswood, birch, and sugar maple and a larger proportion of red and white oaks, hickory, and dead chestnut (table 3).

The cove hardwoods type occupies less than 10 percent of the forest land. It includes the hardwoods typical of the narrow coves and also the northern hardwoods of the upper moist slopes. Yellowpoplar is the leading live species (table 3) although it usually occurs in mixture with basswood, northern red oak, various hickories, hemlock, birch, black cherry, ash, walnut, buckeye, black locust, and dead chestnut. Abandoned fields in the coves have often restocked to pure stands of yellowpoplar. The northern hardwood variation is the typical beech-birch-maple type of the northeastern states. The usual cove hardwoods type affords the best opportunity for commercial timber growing in the mountains but it is difficult to find large contiguous areas of this productive forest.

Of the pine types, shortleaf pine-hardwoods, established on 17 percent of the forest land, is the most extensive. Stands of table mountain and pitch pine are included with this type although they differ in quality and usually grow at higher elevations and on less productive sites. On two-thirds of the type area the pines are in mixture with hardwoods, the remaining area is largely pine alone. Sixty-five percent of the type volume is composed of shortleaf, table mountain, and pitch pines and an additional 10 percent is Virginia and eastern white pine. Red and white oaks are the chief hardwood associates although dead chestnut and yellowpoplar are common.

Table 3. - Species composition of the forest types, 1938

Species	Upland hardwoods	Cove hardwoods	Shortleaf pine-hardwoods	White pine-hardwoods*	Virginia pine-hardwoods	All types
	Percent of cubic volume**					
Shortleaf pine	1.6	0.1	65.2	2.7	17.0	13.9
Eastern white pine	0.8	0.3	2.9	27.2	3.7	4.4
Virginia pine	0.2	0.1	6.9	1.9	52.8	3.8
Eastern hemlock	0.8	2.7	0.1	22.6	0.1	3.4
Red spruce	--	--	--	8.1	--	1.0
Yellowpoplar	3.6	21.0	2.3	3.6	5.8	5.4
Basswood	0.2	7.7	--	0.9	--	1.1
Sugar maple	0.2	3.4	--	0.6	--	0.6
Ash-cherry-walnut	0.6	3.8	--	0.2	0.5	0.8
White oak	7.2	2.2	3.8	3.8	3.9	5.5
Northern red oak	7.1	6.0	0.3	1.4	0.5	4.8
Chestnut oak	9.8	1.1	1.5	1.9	1.6	6.0
Red oak	12.9	0.8	8.9	5.2	6.7	9.7
Red maple	3.0	2.7	0.6	2.5	0.7	2.3
Hickory	6.3	4.5	1.0	1.5	1.3	4.3
Birch	0.7	4.5	0.1	2.8	--	1.2
Black locust	3.5	3.9	0.9	1.0	1.3	2.7
Dogwood-persimmon	0.1	0.2	0.1	0.2	0.2	0.2
Chestnut	35.6	22.4	3.3	7.3	1.1	23.4
Scrub hardwoods	2.0	1.6	1.0	1.3	1.0	1.6
Other hardwoods	3.8	11.0	1.1	3.3	1.8	3.9
Total	100.0	100.0	100.0	100.0	100.0	100.0

*Includes hemlock-hardwoods and spruce-fir types.

**Net cubic volume outside bark of sound trees 5.0 inches d.b.h. and larger.

The white pine-hardwoods type which includes 81,000 acres of hemlock-hardwoods and 23,000 acres of spruce and fir with the 170,000 acres of eastern white pine-hardwoods, amounts altogether to nearly 8 percent of the forest land. The hemlock-hardwoods forest occurs in the coves along the small mountain streams and is widely distributed. The spruce-fir forest consists of a few remnants of the original spruce forest located at the higher altitudes in the Black, Balsam, Unaka, and Blue Ridge Mountains. This type formerly occupied approximately 150,000 acres but clear-cutting followed by severe fires have eliminated most of the spruce-fir forest and it has been replaced by dense, scrubby stands of firecherry and yellow birch. Stands of eastern white pine in mixture with hardwoods are scattered throughout the unit but are most common on the eastern slopes of the Blue Ridge Mountains. Eastern white pine and eastern hemlock are the leading softwoods in the white pine-hardwoods type and the red and white oaks, yellowpoplar, red maple, and dead chestnut are the more abundant hardwoods.

The Virginia pine-hardwoods type, which occupies only five percent of the forest land, occurs most abundantly in Wilkes, Caldwell, Burke, and McDowell Counties. West of the Blue Ridge Mountains Virginia pine often grows with shortleaf pine but it seldom is the dominant tree in the stand. About one-half of the stand volume is composed of other species, notably shortleaf pine, yellowpoplar, red and white oaks, and black locust.

Forest Conditions

In addition to the type classification the forest cover was further classified into forest conditions on the basis of tree-diameter, age, volume-per-acre, and cutting history. It was found that old-growth saw timber occupied 11 percent of the land, sawlog-size second growth only 36 percent, and under-sawlog-size second growth 53 percent (table 4).

Very few large acreages of old-growth timber remain. A few tracts are being operated by the larger band mills in the unit such as the Bemis Lumber Company at Robbinsville and the Gloucester Lumber Company at Rosman. Other old-growth stands are estate properties, held chiefly for their recreational values, and scattered blocks of old-growth saw timber in National Forests. Among the latter is an area along Big Ivey Creek in Buncombe County, an area in Sherwood Forest in Haywood County, and the Fires Creek watershed in Clay County. Farmers also own small patches of old-growth timber, most of it in rather inaccessible locations.

A large part of the old growth has the size and quality of virgin timber but it is not primeval forest untouched by the lumberman, since about two-thirds of the old growth has been sorted over in recent years for selected species or sizes. An even larger proportion has undoubtedly been cut very lightly in the past because when lumbering first began it was the practice to take out only the walnut, cherry, and the finest yellowpoplar, eastern white pine, basswood and white oak. The present old-growth timber is largely in the upland hardwoods type. That part of it growing on the lower slopes is normally excellent timber but the old growth on the high, dry ridges is usually of very poor quality.

Sawlog-size stands of second-growth timber are distributed rather uniformly throughout the unit although they are not the most prevalent forest condition (table 4). About one-third of these stands have had part of their volume removed in light cuttings. The shortleaf pine-hardwoods were least subject to this culling process. One-half of the merchantable second growth is in the upland hardwoods type and one-fourth is in the shortleaf pine-hardwoods.

Stands of young timber below sawlog size occupy the largest acreage and form the most noticeable component of the forest. These young stands are the prospective sources of supply of the wood-using industries and the success with which they are protected and managed will determine the future importance of the forest industries in this unit. Most of the young stands have advanced beyond the reproduction stage and less than one percent of the forest land is clear-cut and not restocking. Nearly 70 percent of the under-sawlog-size forest is the upland hardwoods type.

Table 4. - Forest area classified according to forest condition and forest type, 1938

Forest condition	Upland hardwoods	Cove hard-woods	Short-leaf pine-hdwds.	White pine hdwds.	Virginia pine-hdwds.	Total all types	Proportion of total
	- - - - - - - - - -	- - Acres - -	- - - - - - - - - -				Percent
Sawlog size:							
Old growth:							
Uncut	96,200	12,300	6,500	31,000	--	146,000	4.1
Partly cut	169,600	31,800	19,600	19,500	--	240,500	6.8
Total	265,800	44,100	26,100	50,500	--	386,500	10.9
Second growth:							
Uncut	391,400	70,100	243,000	90,500	43,200	838,200	23.7
Partly cut	241,400	44,800	88,100	58,700	21,200	454,200	12.8
Total	632,800	114,900	331,100	149,200	64,400	1,292,400	36.5
Total sawlog size	898,600	159,000	357,200	199,700	64,400	1,678,900	47.4
Under sawlog size:							
Second growth	1,172,600	154,900	231,600	67,700	106,000	1,732,800	48.9
Reproduction	49,700	8,200	26,100	3,200	20,400	107,600	3.0
Clear-cut	20,400	800	--	3,300	--	24,500	0.7
Total under sawlog size	1,242,700	163,900	257,700	74,200	126,400	1,864,900	52.6
Total all conditions	2,141,300	322,900	614,900	273,900	190,800	3,543,800	100.0
Percent of total	60.4	9.1	17.4	7.7	5.4	100.0	

Site Quality

Forest productivity depends in a large measure upon the quality of the site. In the mountain region site is an important factor because a variety of soil, climatic, and topographic conditions are induced by the wide range in land elevations. The forest land was classified by the Survey into three site classes, good, fair, and poor, using soil and moisture conditions, topographic aspect, elevation, and merchantable height and form of trees as measures of the timber producing capacity.

In table 5 the land area within each forest type has been classified according to site quality. It is immediately apparent that only a small part of the forest land constitutes an above-average site for timber production. As would be expected, the largest absolute and relative acreage of good site is in the cove hardwoods type. The smallest acreage is in the Virginia pine-hardwoods type. About 80 percent of all the forest land is a fair site that will produce mature trees averaging two to three logs. The poor site is generally confined to the dry upper slopes and produces timber of limited commercial value.

Table 5. - Forest area classified according to forest type and site quality, 1938

Forest type	Good (Site 1)	Fair (Site 2)	Poor (Site 3)	Total	Proportion in good site
	- - - - - - - -	- - Acres - -	- - - - - -	- - - - - - - -	Percent
Upland hardwoods	115,800	1,767,800	257,700	2,141,300	5.4
Cove hardwoods	163,900	157,400	1,600	322,900	50.8
Shortleaf pine-hardwoods	26,100	496,600	92,200	614,900	4.2
White pine-hardwoods*	62,800	202,200	8,900	273,900	22.9
Virginia pine-hardwoods	9,800	175,300	5,700	190,800	5.1
Total	378,400	2,799,300	366,100	3,543,800	--
Percent of total	10.7	79.0	10.3	100.0	

*Includes 81,500 acres of hemlock-hardwoods and 22,800 acres of spruce-fir types.

Age

A majority of the forest stands are uneven-aged. Reproduction, saplings, poles and saw-timber trees are often associated in an all-aged forest. Exceptions are the practically even-aged old-growth stands and the second-growth stands that have rapidly occupied clear-cut land and abandoned fields. Although there is a wide range of ages within most forest stands the age of the trees governing the forest type and condition is a fairly accurate basis for estimating the time required to grow the various classes of timber.

Stands of reproduction are customarily less than 20 years old. Under-sawlog-size second growth is usually 20 to 50 years old and most of the second-growth saw timber is 50 to 100 years old. The old-growth stands are 100 to 350 years of age. In general, the trees in the pine and cove hardwoods types are at the lower extreme of the age-range in a given forest condition while the trees in the upland hardwoods type may be many years older than indicated above. About 45 percent of the forest land is occupied by stands less than 40 years old, 35 percent is occupied by stands 40 to 80 years old, and 20 percent is stocked with stands more than 80 years of age. Practically one-half of the forest is too young to contain much saw timber.

Stocking

In the mountain region volume-per-acre is influenced to a great extent by site (table 6). In the coves and on the lower moist slopes, where soil and moisture conditions are favorable for growth, the trees are naturally closely spaced with narrow crowns, and long, clear boles. On the drier sites there are fewer trees per acre, the crowns are larger, and the merchantable stems are shorter. The dry ridge-tops support only an open stand of short, poorly-formed, and often defective trees.

Table 6. - Average volumes per acre by forest type and site-class in uncut second-growth stands, 1938

Forest type and site-class	Under-sawlog-size stands			Sawlog-size stands		
	Well-stocked	Average-stocked	Stocking of average stands	Well-stocked	Average-stocked	Stocking of average stands
	Cords	Cords	Percent	Cords	Cords	Percent
Upland hardwoods:						
Good site	9.2	4.8	52.2	19.7	12.6	64.0
Fair site	6.7	3.3	49.3	13.9	8.6	61.9
Cove hardwoods:						
Good site	12.1	5.5	45.5	34.1	18.6	54.5
Fair site	8.8	3.7	42.0	19.3	12.2	63.2
Shortleaf pine-hardwoods:						
Good site	18.4	13.1	71.2	43.2	26.6	61.6
Fair site	10.8	4.2	38.9	29.4	15.3	52.0

The original forests were probably fully-stocked. Lumbermen commonly cut 20,000 board feet per acre from the coves and a 40-acre tract cut in 1912 near Looking Glass Rock in Transylvania County produced 40,000 board feet of yellowpoplar per acre exclusive of other species.[5] On the moist slopes the stands averaged about 9,000 board feet per acre and on the dry slopes about 3,000 feet.

The average second-growth saw-timber stands of the present do not approach such stocking, partly because they are immature and partly because of the volume lost through the chestnut blight. Until recent years a great deal of the cut-over forest land was also burned over almost annually. As a result many of the second-growth seedlings and saplings were killed and the under-sawlog-size stands were usually badly fire-scarred. Mortality has consequently been high and defective slow-growing trees make up a high proportion of the stand. Under such conditions the growing space has not been fully utilized.

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[5] Frothingham, E. H., 1931. Timber growing and logging practice in the Southern Appalachian Region. U. S. Dept. Agr. Tech. Bul. 250. 93 p. illus.

Reference to table 6 shows that most of the average stands have less than two-thirds the stocking of well-stocked stands. The sound-tree values given here for well-stocked stands are based upon the volume of the best 20 percent of existing stands, weighted by age, in the three forest types and the two site-classes and probably do not represent the stocking attainable under intensive forest management.

Forest Fires

Forest fires are a serious problem in the mountain region because the effects of past fires add to the problems of forest management and the prevention and suppression of new fires requires constant vigilance. Fires are most common between October 15 and December 15, and from March 1 to about May 15, corresponding with the fall period when new-fallen dry leaves are on the ground and with the spring period between the cessation of the winter rains and the growth of new foilage. Most of the fires burn only in the leaf litter, crown fires occur infrequently and only in the extremely dry seasons.

Damage to the forest occurs in several ways. Reproduction and young trees are killed outright, the proportion of undesirable hardwood sprouts on reproduction areas is increased, stand composition is often changed for the worse, and basal fire-scars cause serious losses in volume because many of the scars become infected with wood-decaying fungi. It has been determined that mortality and cull damage caused by a single average fire amounts to $1.55 per average acre of burned-over forest land.[6] Fire-scarred, partially rotten hardwood trees occupy a large amount of growing space in the mountain forests and their elimination is one of the more difficult problems of management.

Continuous planning and action is required to protect the forests from the destructive effects of recurrent fires. Fire control organizations maintained on the Great Smoky Mountains National Park, the Cherokee Indian Reservation, and the Pisgah and Nantahala National Forests protect about one million acres of forest land. On private lands the North Carolina Division of Forestry provides fire protection with funds derived from private Forest Protective Associations and the County, State and Federal governments. In 1937-1938 the Division cooperated with 15 of the 21 counties and with two Forest Protective associations. Unrelenting effort on the part of all fire control agencies keeps the area burned over within reasonable limits. On the Boone Working Circle of the Pisgah National Forest the average annual burned acreage for the past 22 years has been only one-half of one percent of the protected land. This includes the severe fire year of 1926; since that year the annual loss has not exceeded one-quarter of one percent. The trend on private forest land is toward a gradual reduction in the number and size of fires, although bad fire seasons such as the dry fall of 1939 cause violent fluctuations in the downward trend. For example, the North Carolina Division of Forestry reported 68,000 acres of non-federal forest land burned over in the mountain region in the 1939 season, compared to 22,000 acres in 1938.

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[6] Unpublished data of the Appalachian Forest Experiment Station, Asheville, N. C.

VOLUME OF THE FOREST RESOURCES

The sound volume of all living trees and dead chestnut 5.0 inches d.b.h. or larger is included in the 1938 inventory of the forest resource. Estimates of the volume of sound wood (cull deducted) are given in board feet, cords, and cubic feet. Volumes expressed in board feet include only the sawlog portion of saw-timber trees. Softwood saw timber is at least 9.0 inches d.b.h.; yellowpoplar, basswood, ash, cherry, and walnut saw timber is at least 11.0 inches d.b.h.; and other hardwood saw timber is 13.0 inches d.b.h. or larger. Cordwood volumes (wood and bark) contain the sawlog portion of saw-timber trees, the cordwood material in the upper stems of softwood and the upper stems and limbs of hardwood saw timber, the sound stems of both softwood and hardwood under-sawlog-size trees, and the sound volume in cull trees. Under-sawlog-size trees range in diameter from 5.0 inches d.b.h. to saw-timber size. Cubic-foot volumes do not contain bark, otherwise the basis of estimate is the same as for cordwood.

In the following tables of volume certain species have been grouped together. On the basis of board-foot volume shortleaf pine contains 40 percent pitch pine, 20 percent table mountain pine, and a very small amount of eastern redcedar. The red spruce contains about one-fourth Fraser fir. White oak (Q. alba) constitutes 98 percent of the white oak volume, post oak the remainder. The red oaks are chiefly scarlet and black oak, southern red oak makes up only 4 percent of the board-foot volume. Yellow and black birch are almost equally represented in the birch group. In the cherry-ash-walnut group 80 percent of the volume is ash. The other hardwoods consist of blackgum, beech, buckeye, cucumber, sycamore, butternut, and sweetgum. Twenty-six percent of the other hardwood volume is blackgum and 17 percent is beech. The chestnut is dead standing timber sound enough for utilization. It accounts for about one-fourth of the hardwood lumber cut in the region but is shown separately because it is not a part of the hardwood growing stock.

Board-foot Volume

In 1938 the net volume of saw timber in the mountain region was 5.9 billion board feet, inclusive of dead chestnut, when scaled by the International $\frac{1}{4}$-inch rule. Using the Scribner rule the volume was only 5.3 billion feet and by the Doyle rule only 4.1 billion board feet (table 7). The International rule is used for subsequent tabulations of board-foot volume because it gives the most accurate estimate of the amount of green lumber that can be sawed from the saw-timber trees.

Value of species: Softwoods comprise two-fifths of the saw-timber volume in live trees. White and shortleaf pines are highest in value, usually ranging from $2.00 to $5.00 per thousand board feet stumpage. Virginia pine and hemlock are low-value species, seldom bringing more than $1.00 or $2.00 stumpage. Hemlock lumber is not much in demand and a large part of the low-grade hemlock timber cut in this unit is used for pulp. Red spruce is valuable for pulp but the volume is small.

Table 7. - Net volume by the International, Scribner, and Doyle log rules classified according to species-group, 1938*

Species-group	International**	Scribner	Doyle
	Thousand board feet		
Softwoods:			
Shortleaf pine	979,000	818,900	514,200
Eastern white pine	406,100	355,200	263,400
Virginia pine	217,700	179,200	104,100
Eastern hemlock	389,300	358,100	313,300
Red spruce	95,300	81,900	55,700
Total softwoods	2,087,400	1,793,300	1,250,700
Hardwoods:			
Yellowpoplar	451,800	404,600	313,700
Basswood	107,900	96,800	74,400
Sugar maple	54,200	49,600	41,000
Ash-cherry-walnut	52,700	46,800	34,700
Northern red oak	496,400	456,800	388,000
White oaks	303,800	278,100	230,100
Chestnut oak	428,500	393,100	327,800
Red oaks	504,100	455,000	352,700
Red maple	102,000	92,100	74,100
Hickory	189,800	172,600	136,300
Birch	79,500	72,100	57,600
Other hardwoods	251,900	229,800	190,700
Total hardwoods	3,022,600	2,747,400	2,221,100
Chestnut	800,100	740,700	650,200
Total all species	5,910,100	5,281,400	4,122,000

*Does not include volume of timber in Great Smoky Mountains National Park, estimated to be 794 million board feet by the Scribner log rule.

**The scale by this rule approximates green lumber tally.

Yellowpoplar is the most prized of the commonly used hardwoods, stumpage bringing $5.00 to $12.00 per thousand. Basswood, sugar maple, ash, black cherry, and walnut are in the same high-value category. The red and white oaks are cut irrespective of species in logging operations if the individual trees are of suitable quality. Northern red oak usually has the highest stumpage value of the oaks, although white oak good enough for tight cooperage brings a higher price. Chestnut oak has about one-half the stumpage value of northern red oak. Southern red and scarlet oaks are the poorest of the red oak group. Red maple, hickory, beech, birch, and blackgum bring little more than the low-grade oaks. Dead chestnut has a low stumpage value, seldom exceeding $2.00 per thousand board feet. Stands of high-grade timber readily accessible to roads occasionally bring more than the maximum stumpage values quoted.

Table 8. - Net volume by the International $\frac{1}{4}$-inch rule classified according to species-group and forest condition, 1938

Species-group	Sawlog size				Under sawlog size	Total	Proportion of total
	Old growth		Second growth				
	Uncut	Partly cut	Uncut	Partly cut			
	Thousand board feet						Percent
Softwoods:							
Shortleaf pine	30,400	53,700	654,700	160,700	79,500	979,000	19.1
White pine	32,400	36,300	206,300	109,000	22,100	406,100	7.9
Virginia pine	400	1,800	135,800	62,600	17,100	217,700	4.3
Hemlock & spruce	208,800	130,300	94,200	37,900	13,400	484,600	9.5
Total softwoods	272,000	222,100	1,091,000	370,200	132,100	1,087,400	40.8
Hardwoods:							
Yellowpoplar	72,000	44,900	236,300	62,000	36,600	451,800	8.8
Basswood	33,100	14,300	40,900	13,700	5,900	107,900	2.1
Sugar maple	19,200	18,100	2,700	9,400	4,800	54,200	1.1
Ash-cherry-walnut	1,400	15,000	16,100	13,900	6,300	52,700	1.0
Northern red oak	157,000	110,900	124,100	70,400	34,000	496,400	9.7
White oaks	59,800	73,200	96,600	53,400	20,800	303,800	6.0
Chestnut oak	123,200	122,200	106,600	36,200	40,300	428,500	8.4
Red oaks	27,500	80,900	233,800	102,500	59,400	504,100	9.9
Red maple	11,000	37,900	20,000	16,500	16,600	102,000	2.0
Hickory	18,500	59,900	52,000	35,000	24,400	189,800	3.7
Birch	19,900	22,000	16,900	11,600	9,100	79,500	1.6
Other hardwoods	37,300	73,500	68,600	48,900	23,600	251,900	4.9
Total hardwoods	579,900	672,800	1,014,600	473,500	281,800	3,022,600	59.2
Total live species	851,900	894,900	2,105,600	843,700	413,900	5,110,000	100.0
Percent of total	16.7	17.5	41.2	16.5	8.1	100.0	
Chestnut	149,500	127,000	166,200	71,800	285,600	800,100	

Volume by condition: About 24 percent of the softwood saw-timber volume is in old-growth stands, 70 percent is in sawlog-size second-growth stands, and 6 percent is in scattered trees in under-sawlog-size stands (table 8). More than two-thirds of the 494 million board feet of old growth is hemlock and spruce. The hemlock is scattered throughout the mountains, particularly in the less accessible coves. Frequently it was left when the other merchantable timber was cut. The spruce is all at high elevations in practically pure stands. As a source of pulpwood or lumber it is relatively unimportant. The second-growth saw timber is chiefly shortleaf, pitch, and white pine. The shortleaf pine yields good lumber and the location and volumes-per-acre of the stands are favorable for utilization. The pitch pine volume, included with shortleaf pine, is usually less desirable saw timber because many of the trees are of poor quality and often grow on extremely rough terrain. Second-growth white pine saw timber has a ready market but the volume is in scattered trees that must be harvested in conjunction with other species. At present the saw-timber volume in under-sawlog-size stands is unimportant commercially because the volume-per-acre is negligible.

The distribution of the hardwood saw-timber volume by forest condition is unlike that of the softwoods. Old-growth stands contain 42 percent of the volume instead of 24 percent, sawlog-size second-growth stands contain only 49 percent, and under-sawlog-size stands 9 percent. About one-third of the chestnut volume is located in each of the three forest condition classes. The better-quality hardwoods, such as yellowpoplar, basswood, northern red oak, white oak, sugar maple, and ash make up about 60 percent of the volume in uncut old-growth stands, 50 percent in uncut second-growth stands, and only 40 percent in all under-sawlog-size stands.

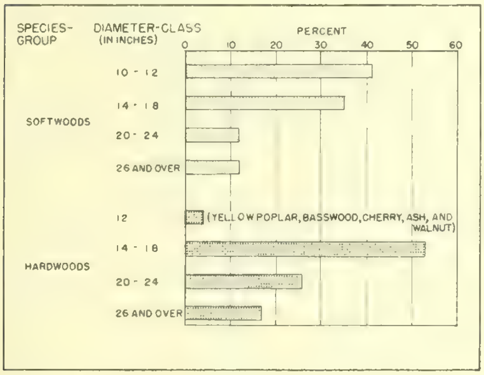

FIGURE 6- DIAMETER DISTRIBUTION OF BOARD-FOOT VOLUME

Volume by diameter class: Among the survey units of North Carolina this unit is unique in that it contains the greatest proportionate area of under-sawlog-size timber and also the greatest proportionate board-foot volume in the larger diameter-classes. Twenty-four percent of the softwood saw-timber volume is in trees larger than 20.0 inches d.b.h. (fig. 6) compared to only 16 percent of the volume in the Northern Coastal Plain where the proportion of large trees is above the average. Hemlock comprises most of the volume in large softwoods. In the hardwoods 43 percent of the volume is in trees larger than 20 inches.

The distribution of the hardwood volume by species-group and diameter-class is indicated in table 9. Since only the yellowpoplar, basswood, and ash were considered saw timber when 12.0 inches d.b.h. the volume in this size-class is small. Over one-half of the volume of sugar maple, northern red oak, and chestnut oak and about one-third of the volume of yellowpoplar and basswood are contained in trees 20.0 inches d.b.h. and larger. Nearly three-fourths of the red oak volume and two-thirds of the red maple, hickory, and birch volume is in trees of the 14, 16, and 18-inch diameter-classes. Species is often more reliable than size as an indicator of quality. Chestnut oak, with one-half of its volume in trees at least 20 inches in diameter yields less than 30 percent No. 1 common and better lumber, while yellowpoplar with only 34 percent of its volume in such large trees yields more than 50 percent of these better grades.

Table 9. - Net board-foot volume of the hardwood saw timber classified according to species-group and diameter-class, 1938

Species-group	Tree diameter-class (inches)				Total	Proportion of total
	12	14, 16, and 18	20, 22, and 24	26 and over		
	Thousand board feet					Percent
Yellowpoplar	95,900	202,200	81,900	71,800	451,800	14.9
Basswood	15,500	54,000	33,900	4,500	107,900	3.6
Sugar maple	--	24,700	20,800	8,700	54,200	1.8
Ash-cherry-walnut	12,900	26,200	11,200	2,400	52,700	1.7
Northern red oak	--	207,700	159,200	129,500	496,400	16.4
White oaks	--	151,500	85,900	66,400	303,800	10.1
Chestnut oak	--	206,200	114,300	108,000	428,500	14.2
Red oaks	--	362,100	119,300	22,700	504,100	16.7
Red maple	--	66,600	19,700	15,700	102,000	3.4
Hickory	--	119,300	54,600	15,900	189,800	6.3
Birch	--	48,400	20,900	10,200	79,500	2.6
Other hardwoods	--	136,700	55,100	60,100	251,900	8.3
Total hardwoods	124,300	1,605,600	776,800	515,900	3,022,600	100.0
Percent of total	4.1	53.1	25.7	17.1	100.0	
Chestnut saw timber	--	236,500	271,700	291,900	800,100	

Distribution by area, volume-per-acre, and site: The distribution of the board-foot volume in the sawlog-size stands has an important influence upon its utilization. In the hardwood types nearly 60 percent of the area is stocked with stands having a volume of less than 2,000 board feet per acre (fig. 7). About three-fourths of the volume in the hardwood types is located on 435,000 acres stocked with more than 2,000 board feet per acre. In general, this acreage will provide the most profitable logging chances.

Volumes-per-acre are heavier in the saw-timber stands of the pine-hardwood types where only 38 percent of the acreage is stocked with less than 2,000 board feet per acre. Eighty-six percent of the volume occurs on the 383,000 acres with heavier stocking.

Combining all types in the sawlog-size condition, 78 percent of the board-foot volume is in stands of more than 2,000 feet per acre but these stands occupy only one-half of the saw-timber acreage. The remaining land is too poorly stocked to provide much saw timber for utilization and reestablishing a satisfactory volume of growing stock on this land is a fundamental problem of forest management.

Site quality has a strong influence upon the volume of growing stock per acre. In figure 7 it is obvious that the good sites (site 1) have the smallest proportionate area with less than 2,000 board feet per acre and the poorest sites have the largest. Likewise the good sites have a high proportion of heavy stands while no stands of more than 6,000 board feet per acre were found on the poorest sites.

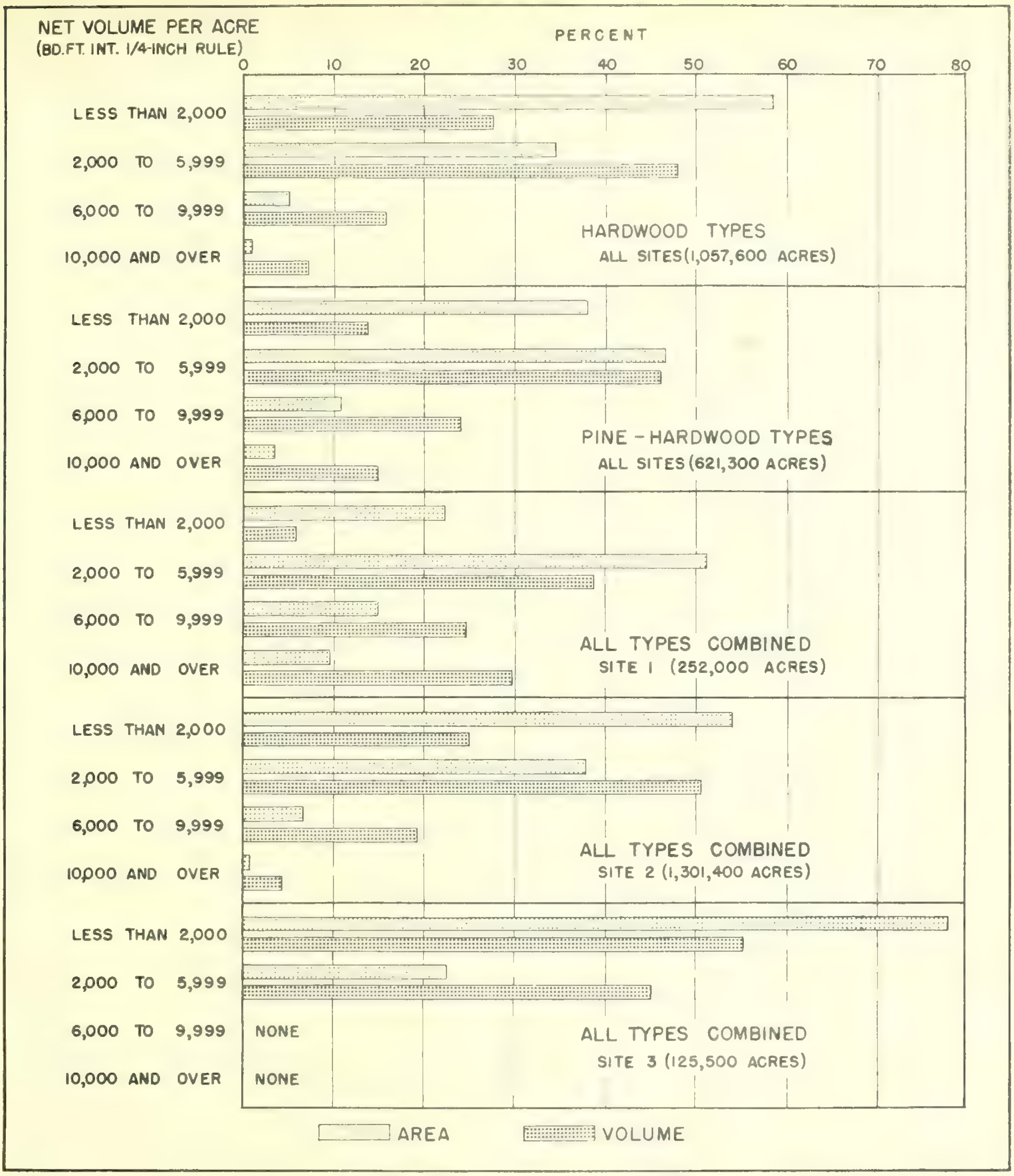

FIGURE 7.- DISTRIBUTION OF AREA AND BOARD-FOOT VOLUME IN THE SAWLOG-SIZE CONDITIONS BY SITE-CLASS AND VOLUME OF SAW TIMBER PER ACRE.

It is apparent that the site 3 land not only has very poor stocking but the nature of the site precludes any great improvement in timber yields. In general, the land classified as site 2 will grow commercial crops of timber. There are about 700,000 acres of land in this site-class with less than 2,000 board feet of growing stock per acre. On part of this land the board-foot volume will be considerably increased in the next 20 years by good-quality trees now below sawlog size. On other areas most of the increase in volume will accrue from trees of inferior quality. In either case the improvement of the growing stock will depend upon fire protection and development of ways to utilize, without financial loss, the poor quality species and individuals. The site 1 land offers the best opportunity for growing timber crops. Timber stands on this site respond most rapidly to stand improvement measures.

Volumes per acre: The heaviest average volume per acre is found in the white pine-hardwoods type (table 10) but this type occupies only 8 percent of the forest area. The cove hardwoods likewise have a heavy volume per acre, especially in old-growth stands, but they too occupy only 9 percent of the forest land. The upland hardwoods type is the most extensive and therefore most important from the forest resource standpoint. Unfortunately, the average volume per acre in this type is exceptionally low, only 1,320 board feet. Even the old-growth uncut stands average only 5,640 board feet. The average volumes of this and the other types clearly indicate a need for building up the growing stock if timber is to be grown at a profit and if forest industries are to maintain or increase their present consumption of wood.

Table 10. - Average board-foot volume per acre by the International $\frac{1}{4}$-inch rule classified according to forest type and forest condition, 1938.

Forest type	Sawlog size					Under sawlog size	Weighted average of all conditions
	Old growth		Second growth		Weighted average		
	Uncut	Partly cut	Uncut	Partly cut			
	Board feet*						
Upland hardwoods	5,640	3,750	1,960	1,590	2,590	400	1,320
Cove hardwoods	11,270	4,920	3,900	2,500	4,280	560	2,390
Shortleaf pine-hardwoods	5,880	3,670	3,140	2,250	3,000	240	1,840
White pine-hardwoods	9,100	8,080	3,890	2,910	4,820	320	3,600
Virginia pine-hardwoods	--	--	2,690	2,390	2,590	200	1,000
	6,860	4,250	2,710	2,020	3,100	380	1,670

*Includes volume of chestnut saw timber.

Economic availability[7]. It is impossible to give an accurate estimate of the amount of board-foot volume that can be manufactured profitably at present without a detailed field examination of each logging unit. Such a procedure was financially impractical on a unit-wide basis. Also, because of the immaturity of a large part of the sawlog-size stands it seemed advisable to obtain an approximation of the board-foot volume operable both now and potentially. Accordingly, careful field observations were made of timber stands, cutting practices, and logging operations and on this basis it was estimated that at least 85 percent of the board-foot volume is operable either now or potentially. In general, potentially operable stands will require a growing period of at least 20 more years before they will support an economic logging operation.

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[7] This section based on a report prepared by James W. Girard, Asst. Director, Forest Survey.

Several factors influenced this estimate. A large proportion of the second-growth sawlog-size stands are not now operable because of low volumes per acre and a preponderance of small, low-value trees. Many of these stands will become operable, however, before the present volume of available timber is exhausted. Practically all of the second-growth timber is topographically accessible because most of it is on land which has been logged or cultivated. If the most difficult logging chances now being operated are accepted as the limitation of future developments there is very little economically unavailable timber.

Quality of hardwood saw timber: An estimate of the quality of the hardwood saw timber was obtained by grading the logs in several thousand sample trees well distributed throughout the mountain region and representative of all forest types, conditions, and commercial species. The log grades used compare closely with grading rules now being used by several band sawmills in this unit. A description of the log grades is included in the glossary.

Table 11. - Proportionate distribution of the hardwood volume by log grade and the estimated yield of No. 1 common and better lumber, 1938*

	Old growth				Second growth			
	Log grade			Yield of No. 1 common and better lumber	Log grade			Yield of No. 1 common and better lumber
	1	2	3		1	2	3	
	Percent							
Yellowpoplar	54	20	26	65	24	26	50	45
Basswood	50	24	26	60	40	20	40	55
Sugar maple	40	24	36	45	30	25	45	38
Cherry-ash	54	22	24	63	40	30	30	55
Northern red oak	54	19	27	62	46	21	33	55
White oaks	24	23	53	35	10	24	66	30
Chestnut oak	27	25	48	25	10	23	67	30
Red oaks	15	21	64	30	10	21	69	32
Red maple	38	27	35	47	25	26	49	40
Birch	31	23	46	54	20	30	50	45
Other hardwoods	20	30	50	40	15	30	55	30

*Based on data obtained by James W. Girard, Asst. Director, Forest Survey.

The results obtained provide a reliable indication of the quality of the saw timber. Table 11 shows the proportionate distribution of the volume of each important hardwood species by log grade for both old-growth and second-growth timber. For instance, 54 percent of the old-growth yellowpoplar volume is in No. 1 logs, 20 percent is in No. 2 logs, and 26 percent is in No. 3 logs. At least one-half of the old-growth yellowpoplar, basswood, black cherry, ash, and northern red oak volume, and over 45 percent of the second-growth northern red oak is in first quality logs. The white oaks, chestnut oak, and the red oaks have a high proportion of their volume in No. 3 logs in both old-growth and second-growth timber. About 35 percent of the old-growth volume and about 20 percent of the second-growth volume in all species is in No. 1 logs.

In addition, the table shows for each species the yield, in percent of total volume, of No. 1 common and better lumber. These yields are obtained from the average mill run of logs by band mills cutting hardwood in the region. The highest proportion, 65 percent, of the better grades is obtained from old-growth yellowpoplar and the lowest, 25 percent, from old-growth chestnut oak. On the average, 45 percent of the lumber cut from old-growth hardwood is No. 1 common or better, compared to 39 percent of the lumber cut from second-growth timber. The disparity is not great and many operators prefer second-growth timber in view of the economies in logging and milling.

Cordwood Volume

Because more than one-half of the forest land is stocked with under-sawlog-size timber, cordwood volumes provide a more comprehensive medium for measuring the wood resource. With chestnut, the total net volume of all trees 5.0 inches d.b.h. and larger, including saw timber, is 51.3 million cords (table 12). Forty-two percent of the volume is in the stems and limbs of sawlog-size trees, 28 percent is in sound trees under sawlog size, and 30 percent is sound material in cull trees.

The total cordwood volume of all living trees, including culls, is about 40 million cords. Softwoods comprise only one-fourth of this volume. In the shortleaf pine species-group the volume of sawlog material greatly exceeds that in the smaller trees. On the other hand, more than 60 percent of the Virginia pine volume is in under-sawlog-size and cull trees. Sawlog material makes up a major portion of the other softwood volume, which is mostly hemlock and white pine.

Three-fourths of the cordwood volume in living trees is hardwood. Sound trees under sawlog size contain more wood than hardwood sawlogs and the volume in cull trees almost equals that in saw-timber material. Cull trees are especially abundant in this unit, making up 28 percent of the cordwood volume of the hardwoods compared to 24 percent in the Coastal Plain and 20 percent in the Piedmont. Forest productivity will remain at a low level so long as cull trees make up such a large proportion of the growing stock. It is extremely difficult to remove cull trees from a forest and break even financially since markets for cull material are hard to develop. A larger quantity of cull hardwood would be used for domestic heating if it compared in performance and cost with coal. Recently, wood-burning stoves of an improved design have been placed upon the market and a greater use of these stoves in this unit would greatly increase the opportunity for disposal of cull hardwoods. It is also possible that some of the cull volume can be used in tanning extract plants. About one-fifth of the cull volume is chestnut oak. The bark of this species is commonly used for making tanning extract but so far none of the extract plants in this unit use the wood. In northern Alabama chestnut oak wood is used commercially in combination with chestnut for this purpose. If this practice were followed here a much larger quantity of raw material would be available, and a new market for some cull chestnut oak would be at hand.

Table 12. - Net cordwood volume of all sound material including bark, 1938

Species-group	Sawlog-size trees: Sawlog material	Sawlog-size trees: Upper stems	Sound trees under sawlog size	Cull trees	Total all classes	Proportion of total
	Cords					Percent
Softwoods:						
Shortleaf pine	2,414,300	628,000	1,577,500	319,000	4,938,800	12.4
Virginia pine	466,900	143,100	666,500	331,700	1,608,200	4.0
Other conifers	1,989,700	393,900	570,900	239,300	3,193,800	8.0
Total softwoods	4,870,900	1,165,000	2,814,900	890,000	9,740,800	24.4
Hardwoods:						
Yellowpoplar-basswood	1,421,600	471,300	1,000,200	358,200	3,251,300	8.2
Ash-cherry-walnut*	284,400	125,900	228,900	178,300	817,500	2.1
Northern red oak	1,236,000	606,000	548,600	728,600	3,119,200	7.8
White oaks	845,900	397,000	1,198,100	789,700	3,230,700	8.1
Chestnut oak	1,376,600	528,500	885,200	1,826,000	4,616,300	11.5
Red oaks	1,552,400	681,500	2,075,700	1,193,900	5,503,500	13.8
Black locust**	--	--	1,002,000	148,100	1,150,100	2.9
Other hardwoods	1,966,400	720,900	2,545,600	3,215,700	8,448,600	21.2
Total hardwoods	8,683,300	3,531,100	9,484,300	8,438,500	30,137,200	75.6
Total all species	13,554,200	4,696,100	12,299,200	9,328,500	39,878,000	100.0
Percent of total	34.0	11.8	30.8	23.4	100.0	
Chestnut	2,502,700	989,400	2,086,400	5,891,900***	11,470,400	

*Includes sugar maple.

**All saw-timber volume included with under-sawlog-size trees.

***Sawlog-size trees suitable for extract wood including upper stems.

Volume by diameter-class: The cordwood volumes of table 13 do not include the sound volume in living cull trees or the volume in upper stems and limbs of sawlog-size hardwoods, hence the living tree volume is 12.9 million cords less than is shown in table 12. Chestnut trees culled for saw timber but suitable for extract wood constitute the chestnut cordwood volume in sawlog-size trees. The sound-tree volume of both the softwoods and the hardwoods is fairly evenly distributed between the diameter classes. By species-group there is some variation. Northern red oak and chestnut oak have a relatively small volume in 6- and 8-inch trees compared to the volume in trees 20 inches and larger. The reverse is true in the white oak and red oak group. More than one-half of the other hardwoods volume is in trees below saw-timber size. Four-fifths of the chestnut wood is in trees 14.0 inches d.b.h. and larger but only 2.5 million cords are suitable for lumber. The bulk of this volume is in cull trees usable for extract wood.

Table 13. - Net cordwood volume of sound trees classified according to species-group and diameter-class, 1938*

Species-group	Tree diameter-class (inches) 6 - 8	10 - 12	14 - 18	20 and over	Total	Proportion of total
	Cords					Percent
Softwoods:						
Shortleaf pine	1,577,500	1,807,200	1,075,900	159,200	4,619,800	17.1
Virginia pine	666,500	451,900	151,800	6,300	1,276,500	4.7
Other conifers	570,900	584,800	781,600	1,017,200	2,954,500	11.0
Total softwoods	2,814,900	2,843,900	2,009,300	1,182,700	8,850,800	32.8
Hardwoods:						
Yellowpoplar-basswood	640,100	674,400	656,700	450,600	2,421,800	9.0
Ash-cherry-walnut	136,600	131,100	135,700	109,900	513,300	1.9
Northern red oak	236,300	312,300	556,800	679,200	1,784,600	6.6
White oaks	600,700	597,400	463,000	382,900	2,044,000	7.6
Chestnut oak	362,300	522,900	736,600	640,000	2,261,800	8.4
Red oaks	904,800	1,170,900	1,149,900	402,500	3,628,100	13.4
Black locust	363,000	380,700	213,200	45,100	1,002,000	3.7
Other hardwoods	1,249,200	1,295,500	1,265,400	701,900	4,512,000	16.6
Total hardwoods	4,493,000	5,085,200	5,177,300	3,412,100	18,167,600	67.2
Total live species	7,307,900	7,929,100	7,186,600	4,594,800	27,018,400	100.0
Percent of total	27.0	29.4	26.6	17.0	100.0	
Chestnut saw timber	--	--	816,200	1,686,500	2,502,700	--
Chestnut cordwood	734,000	1,352,400	2,166,600**	3,725,300**	7,978,300	--

*Cull trees, upper stems and limbs of sawlog-size hardwoods not included.

**Cull trees suitable for extract wood, including upper stems.

Volume per acre: The average volume per acre of all forest types and conditions is 10.8 cords (table 14). This includes the volume of dead chestnut but does not include cull trees or upper stems and limbs of sawlog-size hardwoods. Sawlog-size stands average 16.0 cords per acre, varying from 27.2 in the old-growth uncut condition to 12.6 in the second-growth partly-cut stands. The heaviest average volume per acre occurs in the cove hardwoods type and is composed almost entirely of hardwoods and chestnut. The average volume of the white pine-hardwoods type is nearly as great, however, and is composed of a wider variety of species. Under-sawlog-size stands, which occupy 53 percent of the forest land, contain on the average only 3.5 cords of growing trees per acre.

The stand of chestnut averages 3.5 or more cords per acre in the upland and cove hardwood types but is much less plentiful in the softwood types. It is noticeably more abundant in the old-growth condition and the average volume on the 310,000 acres of old growth in the hardwood types is 8.3 cords.

Table 14. - Average cordwood volume per acre classified according to forest type, species-group, and forest condition, 1938*

Forest type and species-group	Sawlog size					Under sawlog size**	Weighted average of all conditions
	Old growth		Second growth		Weighted average		
	Uncut	Partly cut	Uncut	Partly cut			
	- - - - - - - - - - - - -	Cords	- - - - - - - - - - - - -				
Upland hardwoods:							
Softwoods	0.5	0.5	0.4	0.4	0.4	0.2	0.3
Hardwoods	14.2	11.4	8.1	7.7	9.3	3.0	5.6
Chestnut	11.3	6.9	4.7	3.9	5.6	3.7	4.5
Total	26.0	18.8	13.2	12.0	15.3	6.9	10.4
Cove hardwoods:							
Softwoods	0.9	1.2	0.4	0.3	0.6	0.2	0.4
Hardwoods	25.1	13.0	15.5	10.5	14.3	4.4	9.2
Chestnut	11.7	5.9	3.8	4.3	5.0	2.3	3.6
Total	37.7	20.1	19.7	15.1	19.9	6.9	13.2
Shortleaf pine-hardwoods:							
Softwoods	14.4	8.6	11.9	7.7	10.8	2.9	7.4
Hardwoods	2.9	4.4	2.8	3.9	3.1	1.1	2.3
Chestnut	1.1	1.1	0.5	0.4	0.5	0.4	0.5
Total	18.4	14.1	15.2	12.0	14.4	4.4	10.2
White pine-hardwoods:							
Softwoods	19.4	16.0	10.3	8.7	11.8	2.0	9.1
Hardwoods	6.8	5.5	5.7	5.1	5.7	2.3	4.8
Chestnut	2.3	2.7	1.9	0.9	1.7	1.0	1.5
Total	28.5	24.2	17.9	14.7	19.2	5.3	15.4
Virginia pine-hardwoods:							
Softwoods	--	--	9.6	8.7	9.4	3.4	5.4
Hardwoods	--	--	4.5	3.5	4.1	0.9	2.0
Chestnut	--	--	0.3	0.4	0.3	--	0.1
Total	--	--	14.4	12.6	13.8	4.3	7.5
All types:							
Softwoods	5.1	2.5	5.3	3.3	4.4	0.8	2.5
Hardwoods	13.1	10.6	6.7	6.6	7.8	2.7	5.1
Chestnut	9.0	5.9	2.9	2.7	3.8	2.7	3.2
Average all types	27.2	19.0	14.9	12.6	16.0	6.2	10.8

*Cull trees, upper stems and limbs of sawlog-size hardwoods not included.

**Includes reproduction and clear-cut conditions.

Cubic-foot Volume

The net volume of sound wood in trees 5.0 inches d.b.h. and larger, exclusive of chestnut, has been summarized in cubic feet in table 15. The cubic foot is a more accurate measure of wood volumes than the board foot or cord and, since bark is not included, the data provide a very reliable estimate of the volume distribution between tree classes and species groups.

Table 15. - Net cubic-foot volume of all sound wood, without bark, 1938

Species-group	Sawlog-size trees		Sound trees under saw-log size	Cull trees	Total all classes	Proportion of total
	Sawlog material	Upper stems				
	- - - - - - Thousand cubic feet			- - - - - -		Percent
Softwoods:						
Shortleaf pine	175,070	45,170	106,660	22,570	349,470	13.4
Virginia pine	33,920	10,350	46,780	23,660	114,710	4.4
Other conifers	149,170	29,270	42,640	17,910	238,990	9.2
Total softwoods	358,160	84,790	196,080	64,140	703,170	27.0
Hardwoods:						
Yellowpoplar-basswood	93,300	27,220	60,620	22,900	204,040	7.8
Ash-cherry-walnut*	18,770	7,250	13,910	11,420	51,350	2.0
Northern red oak	82,480	35,400	33,750	47,730	199,360	7.7
White oaks	56,170	23,120	73,380	50,420	203,090	7.8
Chestnut oak	91,490	30,800	54,480	118,480	295,250	11.3
Red oaks	102,110	39,250	127,590	76,000	344,950	13.2
Black locust**	--	--	62,560	9,240	71,800	2.8
Other hardwoods	129,960	41,780	156,000	204,930	532,670	20.4
Total hardwoods	574,280	204,820	582,290	541,120	1,902,510	73.0
Total live species	932,440	289,610	778,370	605,260	2,605,680	100.0
Percent of total	35.8	11.1	29.9	23.2	100.0	

*Includes sugar maple.

**All saw-timber volume included with under-sawlog-size trees.

Supply of Tanning Material

Chestnut wood, chestnut oak bark, and hemlock bark are the important tanning extract materials cut from the mountain forests. Any estimate of the total supply of these materials must be tempered by the realization that part of the chestnut will be used for saw timber and part will decay before it is utilized. Some of the chestnut oak and hemlock bark will also be wasted when unpeeled logs are sawed for lumber. Also much of this material is in National Forests where it will be cut on a management basis over a period of years. As shown in previous tables, about 2.5 million cords of dead chestnut are still suitable for saw timber and almost 8 million

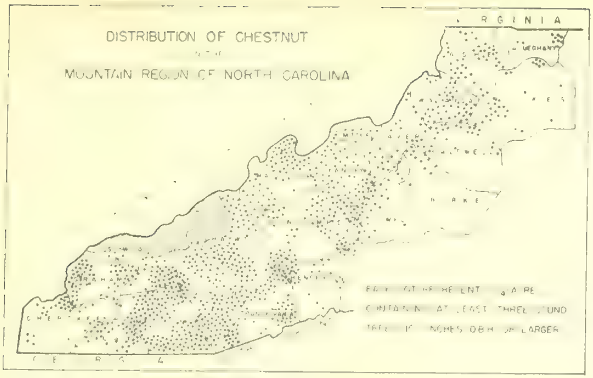
DISTRIBUTION OF CHESTNUT
IN THE
MOUNTAIN REGION OF NORTH CAROLINA
VIRGINIA
ALLEGHANY
ASHE
GEORGIA
EACH DOT REPRESENTS ACRES
CONTAINING AT LEAST THREE SOUND
TREES 10 INCHES D.B.H. OR LARGER

FIGURE 8

cords are suitable only for extract wood. The location of the principal supply of chestnut is shown in figure 8. Estimates of the quantity of bark obtained by applying a conversion factor to the board-foot volume of standing timber are necessarily inexact. For chestnut oak the factor used was 2,240 pounds of bark per thousand board feet by the Scribner rule and for hemlock it was 1,800 pounds per thousand feet. On these bases there are about 440,000 tons of chestnut oak bark and 320,000 tons of hemlock bark. It is estimated that there are an additional 400,000 tons of chestnut oak bark on cull trees, many of which are on the higher, more inaccessible ridges.

INCREMENT OF THE FOREST

Current increment is the net volume of wood produced by the forest growing stock in a single year, 1938 in this report. The board-foot growing stock consists of all sound softwood trees 9.0 inches d.b.h. and larger, all sound yellowpoplar, basswood, black cherry, ash, and walnut trees 11.0 inches d.b.h. and larger, and all other sound hardwood trees 13.0 inches d.b.h. and larger, exclusive of specialty woods such as dogwood and black locust. The growing stock expressed in cords and cubic feet includes all sound trees at least 5.0 inches d.b.h. The 4-inch trees becoming 5.0 inches or more during the year are included in cordwood and cubic-foot tabulations of increment and the under-sawlog-size softwoods and hardwoods that become saw-timber size are included in board-foot increment. The volume in cull trees, chestnut, and in the upper stems and limbs of sawlog-size hardwoods is not considered growing-stock material.

The Interrelation of the Elements of Increment

Increment is the resultant of two opposing factors -- the volume gained by growth and the volume lost through mortality. Total annual growth is composed of (1) the volume recruited from small trees which grow into merchantable sizes, and (2) the volume added by growth to individual trees already of merchantable size, including growth on utilized trees up to the time of their removal from the stand. Mortality consists of the volume lost through the natural death of sound trees.

The mortality in old-growth softwoods in this unit is outstanding (fig. 9) amounting to 147 percent of the total board-foot growth. In addition to being an exceptionally high mortality loss, this is unusual because it is one of the few instances discovered in this survey where mortality exceeds the growth in old-growth stands. In this case it can be attributed to the heavy mortality of large hemlock trees left in partly-cut old-growth stands. Changes in soil moisture and light intensities following cutting are believed to be the chief factors causing death of this shade-tolerant species. Over 90 percent of the mortality loss in these partly-cut stands was hemlock, and the total loss was double that in the uncut old-growth, even though this latter condition contained a greater board-foot volume. Mortality in the other softwood and hardwood stands is not abnormally high and is chiefly due to fire, windthrow, competition, insects, and disease. Fire is probably the most serious causal agent of mortality because it has been extensive and severe and most hardwood species are susceptible to damage by fire. Not only are many trees killed outright but the basal wounds caused by fire open the way to rot-producing fungi which by reducing the trees' vitality, increase the mortality rate. Old age and overcrowding cause some natural mortality but these factors are rather unimportant in the young and generally under-stocked stands occupying over one-half of the forest land.

The importance of recruited volume as a factor of total growth is obvious in figure 9. In the under-sawlog-size softwood stands nearly 85 percent of the total board-foot growth results from trees attaining sufficient size during the year to be classed as saw timber. The proportion of recruited volume decreases in the older stands because of the predominance of sawlog-size trees. It makes up one-fourth of the total board-foot growth in the old-growth hardwoods, and more than compensates for the volume lost through mortality. This balancing effect of recruited volume upon mortality is too often overlooked in general discussions of increment in old-growth stands.

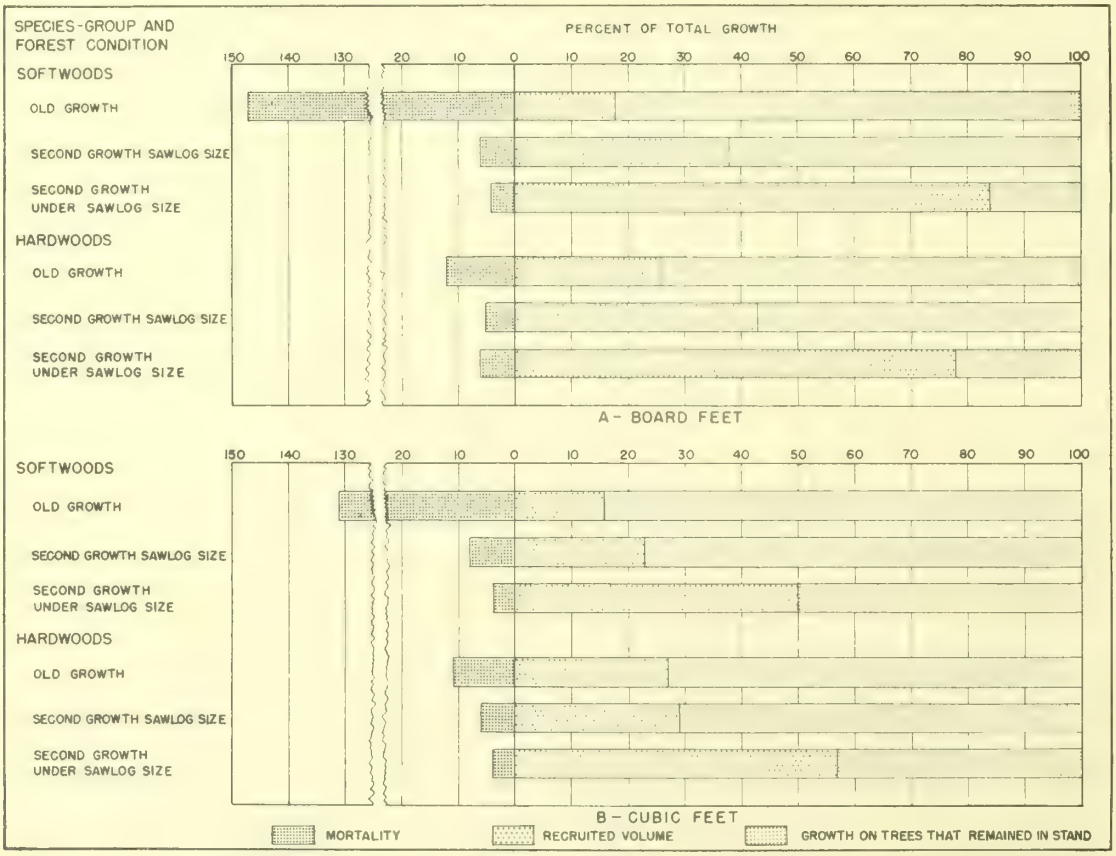

FIGURE 9.- PROPORTIONAL DISTRIBUTION OF THE ELEMENTS OF NET INCREMENT, 1938

Increment of the Total Stand

The total growth of the forest stand in 1938 was 281 million board feet and the total mortality loss was almost 29 million board feet, leaving a net increment of over 252 million feet (table 16). About 60 percent of the increment was hardwood and 40 percent softwood. The old-growth hardwood stands increased through growth by 25 million feet but heavy mortality of old-growth hemlock caused a growing-stock reduction of nearly 4 million board feet in the old-growth softwoods. Eight percent of the net board-foot increment accrued in old-growth stands, 63 percent in second-growth sawlog-size stands, and 29 percent in stands under sawlog size. The increment of all sound trees 5.0 inches d.b.h. and larger amounted to 93 million cubic feet.

Table 16. - Net increment in board feet and cubic feet in the various forest conditions, 1938

Forest condition	Saw-timber material			All sound trees		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
	- Thousand board feet -			Thousand cubic feet (i.b.)		
Sawlog size:						
Old growth	-3,800	25,200	21,400	-540	6,900	6,360
Second growth	75,800	82,800	158,600	18,080	23,800	41,880
Under sawlog size:						
Second growth	33,100	39,300	72,400	13,600	30,680	44,280
Reproduction	Negl.	200	200	10	90	100
Total all conditions	105,100	147,500	252,600	31,150	61,470	92,620

The volume of growth, mortality, and increment in each forest condition is expressed in cords in table 17. In the softwoods the total growth was reduced 12 percent by mortality and in the hardwoods only 5 percent. The total volume lost because of mortality amounted to 115,500 cords. Almost one-fourth of this loss could have been saved if the hemlock had been utilized when the old-growth stands were cut over. About one-half of the total increment was produced in the under-sawlog-size stands which occupy 53 percent of the forest land.

Table 17. - Growth, mortality, and increment in cords in the various forest conditions, 1938

Forest condition	Softwoods			Hardwoods		
	Growth	Mortality	Increment	Growth	Mortality	Increment
	- - - - - - - - - - - - - Cords - - - - - - - - - - - - -					
Sawlog size:						
Old growth	22,600	29,600	-7,000	121,200	13,200	108,000
Second growth	274,600	21,200	253,400	405,600	24,100	381,500
Under sawlog size:						
Second growth	203,400	7,800	195,600	525,900	19,400	506,500
Reproduction	300	100	200	1,400	100	1,300
Total all conditions	500,900	58,700	442,200	1,054,100	56,800	997,300

Increment per Acre

The average annual increment per acre varies noticeably by forest type and condition. In table 18 the calculated full year's growth of the trees utilized is included, therefore the values are representative of increment on stands undisturbed throughout the year.

The most outstanding fact brought out by this table is the low average board-foot increment per acre, 72 board feet compared to 163 in the North Carolina Northern Coastal Plain and 149 board feet in the Piedmont. The cove hardwoods and the pine-hardwoods types are reasonably productive but the increment of the upland hardwoods type, which occupies 60 percent of the forest land, was only 91 board feet in its most productive forest condition. This low increment is partly a result of poor sites and slow growth rates but a more important contributing factor is the small volume of growing stock per acre in the upland hardwood type, averaging only 2,150 board feet in the saw-timber conditions, exclusive of dead chestnut.

In their present under-stocked condition the upland hardwood forests offer the private timberland owner little incentive to practice forestry. Even with an average stumpage price of $5.00 per thousand for all species the present increment in the most rapidly growing stands is worth less than 50 cents per acre per year. In many cases, however, the income can be gradually increased if the land-owners are able and willing to forego immediate income. Increment can be increased both in quality and quantity if the low-grade material now making up such a high proportion of the growing stock is removed and if the annual cut of good trees is restricted to less than the annual increment until a heavier stand per acre is developed. Farm operators are in an advantageous position to improve their farm woodlands because they can use such large quantities of cull material for fuelwood and fencing.

Table 18. - Average increment per acre classified according to forest condition and forest type, 1939

Forest condition	Saw-timber material						All sound trees in all types	
	Upland hdwds.	Cove hdwds.	Short-leaf pine-hdwds.	White pine hdwds.	Virginia pine-hdwds.	Average of all types	Including bark	Excluding bark
	Board feet						Cords	Cu.ft.
Sawlog size:								
Old growth:								
Uncut	73	147	16	44	--	71	.26	17.4
Partly cut	65	78	-28	-79	--	47	.25	16.2
Second growth:								
Uncut	91	206	163	198	140	136	.52	35.1
Partly cut	75	125	128	162	136	104	.44	29.2
Under sawlog size:								
Second growth	34	54	61	69	58	42	.42	26.7
Reproduction	1	3	--	--	--	1	.01	.4
Weighted average	52	101	105	117	79	72	.41	26.9

Although badly depleted, the forests of the mountain region provide raw material for over 600 wood-processing plants. Sawmills are most numerous but 35 plants manufacture dimension stock, shuttle blocks, veneer, pulp and paper, excelsior, cooperage, or tanning extract. A large quantity of fuelwood is cut each year, and some crossties and poles.

The Lumber Industry

The following description of the lumber industry is based upon data obtained by a mill-to-mill canvass in 1937. In 1938 there was an 11 percent decrease in the number of mills and a 22 percent decrease in lumber production but the general character of the industry did not change. In 1937 about 642 sawmills were operating in the unit (table 19). Over 600 of these were small mills with a cutting capacity of less than 10,000 board feet per day and the rest had capacities of less than 40,000 board feet. The mills were distributed throughout the unit but were most abundant in the counties lying northeast of the French Broad River (fig. 10). Their total cut amounted to 247 million board feet: 57 percent hardwoods, 23 percent softwoods, and 20 percent sound dead chestnut.

Table 19. - Descriptive summary of lumber production in sawmills of various size-classes, 1937

Item	Capacity in thousand board feet per 10-hour day			All mills
	1 - 9	10 - 19	20 - 39	
Number of sawmills, 1937	601	30	11	642
Avg. production per mill (M bd.ft.)	264	1,283	4,536	385
Total production (M bd.ft.)	158,600	38,500	49,900	247,000
Percent production sold rough	80	75	55	75
Avg. number of employees in sawmill	4	13	36	5
Man-hours to produce 1,000 board feet:				
In woods	10	20	20	13
In sawmill	11	13	13	12
Percent of mills using:*				
Circular saws	100	85	20	95
Band saws	Negl.	15	80	5
Edgers	40	100	100	45
Planers	5	25	25	5
Dry kilns	0	5	25	Negl.

*To the nearest five percent.

Mills of 1-9 M capacity: The 601 small sawmills operating in the unit in 1937 (table 19) produced 64 percent of all lumber. By species-groups they cut 30 percent softwoods, 20 percent chestnut, and 50 percent hardwoods. They cut a much higher proportion of pine than the larger mills, producing four-fifths of all the pine lumber manufactured in the mountain region. About 75 percent of the softwood and 40 percent of the hardwood lumber was sawed from second-growth timber.

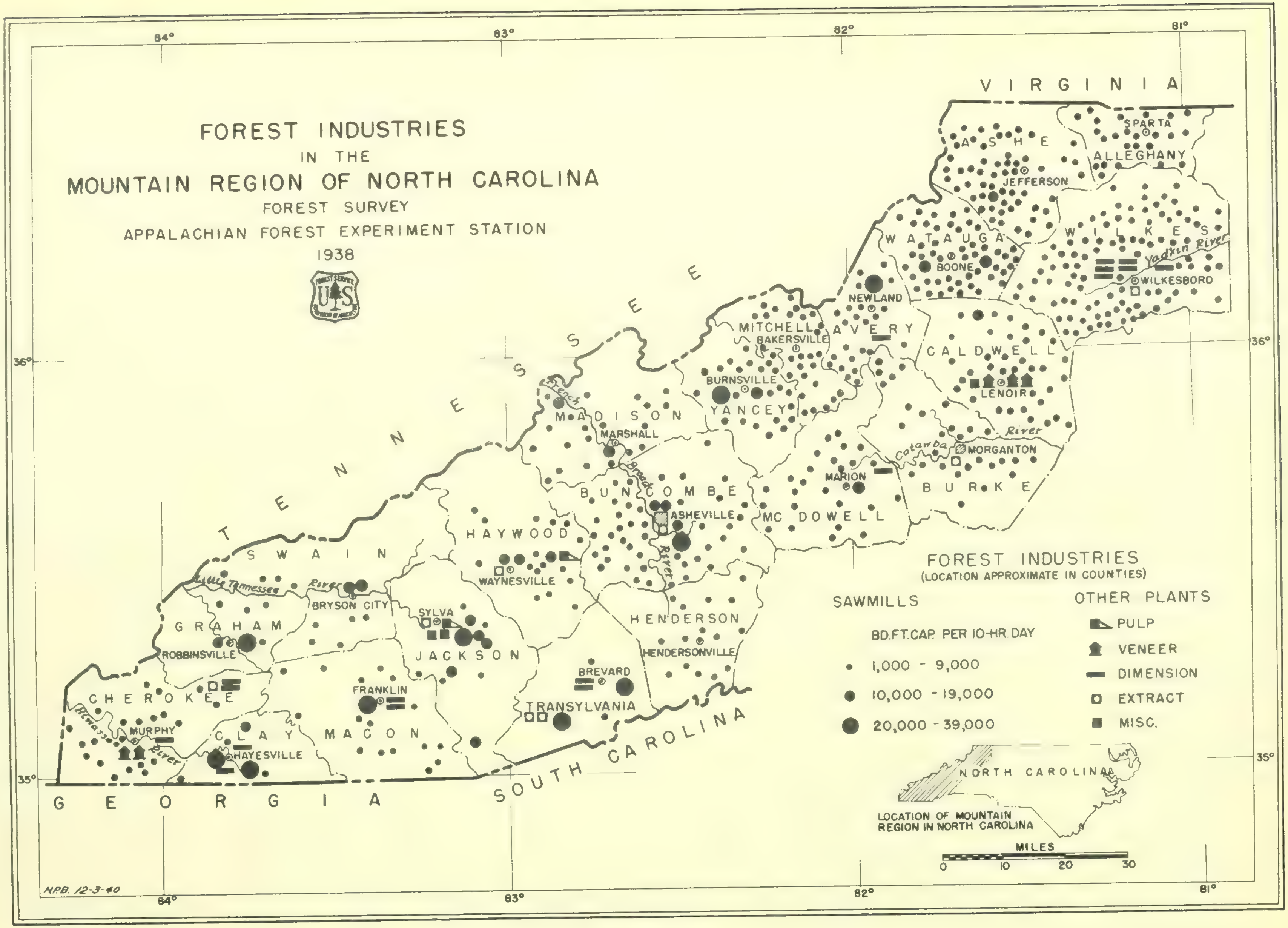
FOREST INDUSTRIES
IN THE
MOUNTAIN REGION OF NORTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1938
FOREST INDUSTRIES
(LOCATION APPROXIMATE IN COUNTIES)
SAWMILLS
BD.FT.CAP. PER 10-HR. DAY
● 1,000 - 9,000
● 10,000 - 19,000
● 20,000 - 39,000
OTHER PLANTS
PULP
VENEER
DIMENSION
EXTRACT
MISC.
LOCATION OF MOUNTAIN REGION IN NORTH CAROLINA
NORTH CAROLINA
MILES
0
10
20
30
VIRGINIA
TENNESSEE
GEORGIA
SOUTH CAROLINA
ASHE
ALLEGHANY
SPARTA
JEFFERSON
WILKES
WILKESBORO
Yadkin River
WATAUGA
BOONE
AVERY
NEWLAND
CALDWELL
LENOIR
MITCHELL
BAKERSVILLE
YANCEY
BURNSVILLE
MADISON
MARSHALL
French
Broad
River
BUNCOMBE
ASHEVILLE
MC DOWELL
MARION
BURKE
MORGANTON
Catawba River
HAYWOOD
WAYNESVILLE
HENDERSON
HENDERSONVILLE
TRANSYLVANIA
BREVARD
SWAIN
BRYSON CITY
Little Tennessee River
GRAHAM
ROBBINSVILLE
JACKSON
SYLVA
MACON
FRANKLIN
CHEROKEE
MURPHY
Hiwassee River
CLAY
HAYESVILLE
84°
83°
82°
81°
36°
35°
M.P.B. 12-3-40

FIGURE 10

In equipment and operating organization these small mills are typical of portable mills throughout the South. Practically all of them use circular saws, less than one-half have edgers, and only a few have planers. About one-half are powered by gasoline or diesel motors, 45 percent by steam engines, 3 percent by water, and a few by electricity. On the average, 4 men are employed at each mill with 4 more in the woods cutting and hauling timber. Logging is done with teams and most of the logs are skidded directly to the mill. It is customary for these small mills to buy stumpage and move the mill to the timber, and 85 percent of the cut was obtained in this way. Only 3 percent of the logs were purchased delivered at the mill, while 12 percent were brought to the mill and sawed on a fee basis. About one-fourth of the mills do custom sawing and these mills are usually at a permanent location.

Mills of 10-19 M capacity: Thirty sawmills of this size were operating in 1937. They cut about 16 percent of the total lumber produced. Including chestnut, 86 percent of their cut was hardwood. Over four-fifths of the saw timber was cut from old-growth stands.

Two-thirds of these mills are semi-permanent but the rest move almost as frequently as the smaller portable mills. Only four of the mills used band saws. Steam engines are the favored source of power, although three mills used electricity, one used water, and one a motor unit. The most unusual mill encountered was a water-powered band mill in Watauga County which was complete with edger, trimmer, and log turner. The average mill employed 13 men and the number of woods workers per operation varied from 5 to 40. Logging was done with teams and the logs were skidded directly to most of the portable mills. Trucks were used for transporting logs from the woods to the semi-permanent mills. Three-fourths of the saw timber was purchased as stumpage and the remainder was bought as logs delivered at the mill yard.

Mills of 20-39 M capacity: Only 11 sawmills in the unit have a cutting capacity of 20,000 or more board feet per day. The Carr Lumber Company at Pisgah Forest and the Bemis Lumber Company at Robbinsville are the largest operators but the Gloucester Lumber Company at Rosman and the Blackwood Lumber Company at East Laporte closely approach them in quantity of lumber sawed. The 11 mills cut almost 50 million feet of lumber in 1937, about 20 percent of the total production. Over 90 percent of their cut was mixed hardwoods and chestnut and practically all of the sawlogs used were cut from old-growth timber.

All but two were band mills. Steam was the primary power in all mills. Employees per mill averaged 36, although there was a wide range among mills. Loggers varied in number from 10 to 85 per operation. Skidding was done with teams and most of the logs were brought to the mill by truck. The Bemis Lumber Company is the only one still operating a logging railroad. About 45 percent of the logs were purchased as stumpage, 35 percent were purchased delivered at the mill yard, and 20 percent were cut from lands of the operating lumber companies.

Production in 1937 and 1938: The number of operating sawmills decreased from 642 in 1937 to 570 in 1938 and the production of lumber decreased from 247 million board feet to 193 million feet, a reduction of 22 percent (table 20). Mills of all capacities were affected but those with a cutting capacity of 10,000 to 19,000 board feet per day reduced their cut most. In 1938 the production of hardwood lumber, including chestnut, declined about one-fourth, whereas the production of softwood lumber, chiefly yellow pine, was maintained at almost the 1937 level.

Table 20. - Lumber production in 1937 and 1938, classified according to size of mill

Rated capacity (10-hr. day)	Lumber production - 1937				Lumber production - 1938*			
	Softwood	Chestnut	Hardwood	Total	Softwood	Chestnut	Hardwood	Total
M board feet	- - -	M board feet	- -		- -	M board feet	- - -	
1 - 9	46,800	31,800	80,000	158,600	46,200	25,300	61,400	132,900
10 - 19	5,200	8,700	24,600	38,500	3,300	6,700	15,000	25,000
20 - 39	4,400	10,100	35,400	49,900	4,600	5,800	25,100	35,500
Total	56,400	50,600	140,000	247,000	54,100	37,800	101,500	193,400

*Compiled from data obtained cooperatively with the Bureau of the Census for mills which cut more than 50 M bd.ft. per year. The cut of 106 small mills which sawed less than 50 M feet is included (1,200 M bd.ft. of softwood, 500 M bd.ft. of chestnut, and 1,200 M bd.ft. of hardwood lumber).

Lumber prices: The selling price of hardwood lumber is influenced by several factors which are in turn modified by general market conditions. There is a wide range in the value of the various species, quality of saw timber affects lumber grades, manufacturing processes affect the value of the finished lumber, and different operators possess varying degrees of bargaining power. As a rule the larger, well-equipped sawmills obtain better prices for their lumber than do the smaller mills. This is evident in table 21, which shows the average prices received in 1939 for rough lumber of various species by a representative sawmill in each of the designated capacity-classes.

Table 21. - Average selling price of rough lumber at a sawmill of indicated cutting capacity, 1939

Species	Capacity in thousand board feet per 10-hour day				
	30	25	12	8	4
	- - - - - - Dollars per thousand board feet - - - - - -				
Cherry	44	35	--	--	--
Sugar maple	40	30	35	28	25
Ash	38	30	30	20	17
Yellowpoplar	37	25	25	22	18
Birch	36	30	--	25	--
Basswood	35	30	25	25	--
Oak	25	21	25	26	18
Beech	24	--	23	--	--
Buckeye	20	18	--	--	--
Chestnut	19	20	18	14	16

Other Forest Industries

In addition to sawmills there were about 35 plants using wood or bark as a primary raw material in 1938. The largest plants were the two pulp and paper mills located at Canton and Sylva. Eleven plants made hardwood dimension stock, 6 made shuttle blocks, 8 used wood or bark for making tanning extract, 5 made veneer, and one each made excelsior, insulator pins, and tight cooperage. The dimension stock mills and veneer plants used about 10 million board feet of hardwood and the remaining plants used about 320,000 cords of pine, hardwood, and dead chestnut and 20,000 tons of chestnut oak and hemlock bark.

Hardwood dimension stock: In 1938 there were two more dimension stock mills than in 1937. The 11 mills operating during 1938 used 1.8 million board feet of hardwoods and 400,000 board feet of pine. The hardwood was used for furniture stock and the pine for crating. About 30 percent of the hardwood was yellowpoplar, 25 percent was maple, 25 percent was hickory, 15 percent was white oak, and the rest was beech, birch, and walnut. Practically all of the logs were purchased delivered at the mill. Six of the mills were located near North Wilkesboro in Wilkes County. All of the mills are small and only 50 men were employed in the 11 plants.

Veneer: The consumption of hardwood by the five veneer plants decreased from 8 million board feet in 1937 to 7.3 million feet in 1938. A large proportion of the veneer was made from yellowpoplar, but basswood, maple, sweetgum, blackgum, white oak, and even hickory were used. At least three-fourths of the veneer bolts were cut from old-growth timber and all of them were purchased delivered at the plant.

Seventy-three percent of the wood used for veneer in 1938 was cut in this unit, 23 percent was brought from South Carolina, and 4 percent from Georgia. Yellowpoplar bolts trucked 70 miles from South Carolina were delivered at Lenoir for about $22.00 per thousand board feet Doyle scale although number 1 bolts brought as high as $32.50 per thousand feet and number 2 bolts as low as $12.50 per thousand.

Shuttle blocks: Although the number of shuttle block mills decreased from seven in 1937 to six in 1938 the total consumption of wood increased from 780 cords to 890 cords. Dogwood was used by all of the plants except one which used beech, birch, and maple. Plant capacities ranged from one-third to three cords per day and the average mill employed 3 workers. The wood was purchased by the cord from local farmers and a large proportion of the rough blocks were shipped to Greenville, South Carolina, and Charlotte, North Carolina, for manufacture into shuttles.

Pulpwood and extract wood: The Champion Paper and Fibre Company at Canton is the largest user of pulpwood and extract wood. It makes a diversity of products including ground wood, bleached sulphite, sulphate, and soda pulps, kraft, writing, and specialty papers, and is the largest producer of tanning extract in the United States. The Sylva Paperboard Company at Sylva is also an integrated operation making tanning extract and chestnut paperboard for corrugating. Eight other plants make tanning extract from chestnut wood and the bark of chestnut oak and hemlock. In 1938 the 10 extract plants used 170,000 cords of chestnut wood and about 20,000 cords of oak and hemlock bark.

Excelsior, insulator pins, and cooperage: In 1938 a plant at Lenoir made excelsior, one at Dillsboro made insulator pins, and a tight cooperage plant operated at Sylva. Altogether these three plants used about 1,900 cords of wood and gave employment to about 55 men. Two-thirds of the excelsior was made from pine and the rest from yellowpoplar. The peeled wood was purchased by the 144 cubic-foot unit delivered at the plant. The insulator pins were made of oak and the wood was bought in the form of split pieces measuring 18 x 1-3/4 x 1-3/4 inches. On the average six pins were obtained from each piece. The cooperage plant used white oak for the manufacture of whiskey and oil barrel staves. A cord of wood yielded about 250 staves.

Fuelwood: The estimated total consumption of fuelwood in 1938 was 787,000 cords, about 70 percent hardwoods and 30 percent pine. Three-fifths of the wood was obtained from cull trees, sawmill slabs, and tops of trees felled for other uses and the rest was obtained from the sound-tree growing stock. Farmers used 82 percent of the fuelwood, rural non-farm residents 14 percent, and urban dwellers, schools, and small commercial establishments only 4 percent. About 3,000 cords of wood were used for flue-curing tobacco in the northeastern counties of the unit. The average farm family used 14.0 cords of fuelwood, the average rural non-farm family 4.0 cords, and the average urban family only 1.5 cords.

Other products: Numerous timber products not manufactured in local plants were cut from the forests of this unit. The amount of wood cut by farmers for fence posts and farm construction was estimated to be 28,000 cords. Over 15 million board feet of sawlogs were shipped to sawmills in Tennessee and the Piedmont of North Carolina. About 1,400 cords of chestnut extract wood and 23,000 cords of hardwood pulpwood and distillation wood were also drawn from this unit by Tennessee mills. Railroads and treating plants purchased about 8,000 locust posts and 100,000 hewn hardwood crossties. Power, telephone, and railway companies bought 2,400 poles, chiefly locust and chestnut. About 300,000 board feet of veneer bolts were trucked to veneer plants in the Piedmont of North Carolina. It is apparent that the forests of this unit can supply a great variety of raw material for wood-using industries. There is need, however, for developing new industries to use low-quality species and sound material in cull trees.

Employment and Income

In 1938 the primary wood-using industries including fuelwood, provided about 2.3 million man-days of employment, equivalent to 9,340 man-years of 250 days each (table 22). The 605 forest products plants employed about 6,600 men, many of whom worked part-time, and furnished one-third of the total man-days of employment. About 3,000 men worked in sawmills, 2,700 worked in pulpmills, 600 in extract plants, 200 in veneer plants, and the remainder in dimension, shuttle block, cooperage, excelsior, and insulator pin mills. At 25 cents an hour the mill workers received about 1.9 million dollars in wages or $285 per worker per year.

Two-thirds of the total employment was utilized in cutting fuelwood, crossties, poles, and raw material for the wood-using plants. Preparing fuelwood and other material for domestic use called for the expenditure of nearly one million man-days of labor, three-fifths of all the woods employment. Only 609,000 man-days were spent in cutting sawlogs, bolts, crossties, poles, pulpwood, and extract wood for a cash income. The total number of men who obtained part or all of their income from industrial woods work is unknown, but if each worker were occupied 250 days per year only 2,440 individuals would have been employed. It is probable that most workers averaged around 100 days per year in which case about 6,000 men worked in the woods. Their income was about 1.5 million dollars in 1938.

Table 22. - Production and employment in the primary forest industries, 1938

Commodity	Number of plants	Material cut in woods	Produced or used by plants	Employment provided		
				In woods	In plants	Total
		- M board feet -		- M man-days of 10 hours -		
Lumber	570	204,300	193,400	265	225	490
Veneer	5	5,600	7,300	15	41	56
Hardwood dimension	11	2,200	2,200	4	6	10
		M pieces				
Hewn crossties	--	102	--	14	--	14
Poles and posts	--	11	--	1	--	1
		M cords				
Fuelwood	--	787	--	944	--	944
Misc. farm wood	--	28	--	31	--	31
Shuttle blocks	6	1	1	3	3	6
Extract and pulpwood*	10	268	336	304	470	774
Misc. mfg. products**	3	2	2	3	5	8
Total	605	--	--	1,584	750	2,334

*Includes both wood and bark.

**One cooperage plant, one excelsior plant, and one insulator pin plant.

COMMODITY DRAIN

The commodity drain from the sound-tree growing stock includes both the material utilized and the sound usable material left in felled trees. The drain on the saw-timber portion of the trees, including both the utilized and wasted portions, is expressed in board feet, whereas the volumes given in cubic feet and cords include drain on saw-timber material, upper stems of sawlog-size softwoods, and small trees ranging from 5.0 inches d.b.h. to sawlog size. The drain on hardwood tops and on dead chestnut is not included.

The drain upon saw-timber material in 1938 amounted to 98 million board feet of softwoods and 155 million feet of hardwoods (table 23). Forest industries and domestic consumers within the unit used about 89 million board feet of softwoods and 9 million feet were taken to sawmills in the Piedmont of North Carolina. About 145 million feet of the hardwood drain were used within the unit and 10 million feet were sold to sawmills and veneer plants in the North Carolina Piedmont and to sawmills and pulpmills in Tennessee. The movement of rough wood into the unit exceeded the shipments to other areas by three million board feet.

The total drain upon the sound-tree growing stock 5.0 inches d.b.h. and larger was 66 million cubic feet, 62 percent hardwoods and 38 percent softwoods. About 72 percent of the hardwood and 86 percent of the softwood cubic-foot drain was obtained from saw-timber trees. The greatest use of under-sawlog-size trees of both species-groups was for fuelwood, although 1.3 million cubic feet of small hardwoods were cut for pulpwood. Lumber, fuelwood, and pulpwood accounted for over nine-tenths of the total cubic-foot drain.

Table 23. - Commodity drain from the sound-tree growing stock, 1938

Commodity	Saw-timber material			All sound trees*		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
	Thousand board feet			Thousand cubic feet		
Lumber	63,900	111,000	174,900	13,800	20,740	34,540
Veneer	--	5,900	5,900	--	1,100	1,100
Dimension stock	400	1,900	2,300	90	360	450
Shuttle blocks	--	--	--	--	60	60
Pulpwood	15,000	3,800	18,800	3,950	2,110	6,060
Poles and posts	--	--	--	--	40	40
Crossties	200	6,400	6,600	40	1,210	1,250
Fuelwood	17,000	23,700	40,700	6,340	14,430	20,770
Misc. farm use	900	1,800	2,700	550	910	1,460
Misc. mfg. products	300	300	600	80	50	130
Total	97,700	154,800	252,500	24,850	41,010	65,860

*Total drain from growing stock expressed in cords of wood with bark: 343,500 cords of softwoods, 632,100 cords of hardwoods.

COMPARISON OF INCREMENT WITH COMMODITY DRAIN

The commodity drain upon a forest represents the contribution of the resource to industry, employment, and domestic needs. Those benefits generally increase in proportion to the volume of wood utilized. For permanent benefits, the forest must yield enough wood each year, on the average, to compensate for the annual drain. Also, when the forests are badly depleted, as are those of the mountain region, the increment should be greater than the drain so that the growing stock can have an opportunity to increase and fully occupy the forest land. As in other crops, partial stands yield only partial harvests.

Comparison in Board Feet

The over-all effect of utilization upon the board-foot growing stock is indicated in table 24. The net increment of the softwood stand exceeded the drain by seven million board feet, a relatively insignificant surplus as it increased the growing stock by less than one percent. Although the stand increased slightly the cut was made at the expense of the better-quality material. In the old-growth softwoods the drain amounted to 27 million board feet while the total growth was only 8 million feet. Further reductions were caused by mortality and altogether the old-growth stands decreased by 31 million feet. In the second-growth stands increment exceeded drain by a considerable margin, especially in the under-sawlog-size stands where the board-foot drain was minor and the saw-timber volume recruited from young trees amounted to more than 29 million board feet.

Table 24. - Comparison between increment and drain of saw-timber material, 1938

Item	Softwoods	Hardwoods	Total
	- - - Thousand board feet - - -		
Net growing stock, January 1, 1938	2,080,000	3,029,900	5,109,900
Growth, 1938	123,500	157,800	281,300
Mortality, 1938	18,400	10,300	28,700
Net increment, 1938	105,100	147,500	252,600
Commodity drain, 1938	97,700	154,800	252,500
Net change in growing stock, 1938	+7,400	-7,300	+100
Net growing stock, December 31, 1938	2,087,400	3,022,600	5,110,000

In the hardwoods, increment failed to equal commodity drain. The high-quality old-growth saw timber is being cut about three times as fast as it is growing and before many years the old-growth timber in private ownership will be exhausted. When it is, most of the band mills within this unit will be forced to close down unless they can obtain enough timber from the National Forests and outside sources. The second-growth saw-timber stands cannot, in their present condition, be relied upon to support a greater cut because drain already almost equals increment. The future of the hardwood industry lies in the under-sawlog-size stands which occupy such a large part of the forest area. These stands were increasing at the rate of 34 million board feet per year in 1938, but in general it will be several decades before they produce operable saw timber.

Comparison in Cubic Feet

The influence of the large volume of young, under-sawlog-size hardwood growing stock is apparent in the cubic-foot comparison of increment and drain given in table 25. In contrast with the hardwood saw-timber stands, which are decreasing, the total stand of this class increased nearly two percent.

Table 25. - Comparison between increment and drain of all sound material, 1938

Item	Softwoods	Hardwoods	Total
	Thousand cubic feet (i.b.)		
Net growing stock, January 1, 1938	632,730	1,136,110	1,768,840
Growth, 1938	35,480	65,080	100,560
Mortality, 1938	4,330	3,610	7,940
Net increment, 1938	31,150	61,470	92,620
Commodity drain, 1938	24,850	41,010	65,860
Net change in growing stock, 1938	+6,300	+20,460	+26,760
Net growing stock, December 31, 1938	639,030	1,156,570	1,795,600

The net change in growing stock shown in table 25 has been separated into its constituent parts in table 26 to show in which forest conditions and diameter-groups the losses and gains occurred. In the softwoods there was a loss in volume in old-growth saw-timber trees and also in the small trees of the second-growth sawlog-size stands. The old-growth hardwoods of saw-timber size are decreasing and not now being replaced even in quantity by second-growth timber. As time passes, however, the saw-timber growing stock will be greatly augmented by the small trees at present in under-sawlog-size stands.

Table 26. - Change in growing stock by forest conditions and diameter-groups, 1938

Forest condition	Softwoods			Hardwoods		
	5.0 - 8.9 inches d.b.h.	9.0 inches d.b.h. and larger	Total	5.0 - 12.9 inches d.b.h.	13.0 inches d.b.h. and larger	Total
	- - M cu.ft. (i.b.) - -			- - M cu.ft. (i.b.) - -		
Old growth	90	-6,510	-6,420	2,130	-9,180	-7,050
Second growth:						
Sawlog size	-780	3,100	2,320	1,740	1,680	3,420
Under sawlog size	4,420	5,980	10,400	17,890	6,200	24,090
Total all conditions	3,730	2,570	6,300	21,760	-1,300	20,460

Comparison in Cords

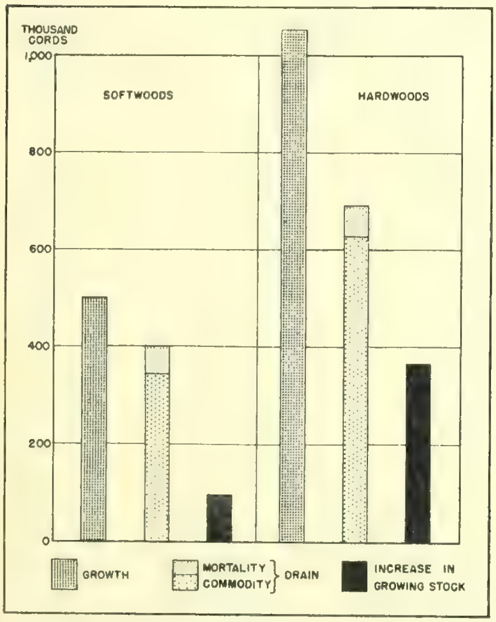

FIGURE 11-COMPARISON OF GROWTH WITH MORTALITY AND COMMODITY DRAIN, 1938.

The relation of total growth to mortality and commodity drain and the resulting change in growing stock are presented in cords in figure 11 which shows that the total increase in stand volume amounted to 99,000 cords of softwoods and 365,000 cords of hardwoods. There was not, however, an increase in all forest conditions. In the old-growth stands there was a decrease of about 88,000 cords in the softwood volume and about 101,000 cords in the hardwood volume. There was a small increase in the second-growth sawlog-size stands amounting to about 36,000 cords of softwoods and 66,000 cords of hardwoods but the most striking increase occurred in the under-sawlog-size stands where the softwoods increased by 151,000 cords and the hardwoods by 400,000 cords. The above figures indicate that both the old-growth and second-growth saw-timber stands are being overcut, and although not apparent in these totals, the cutting is generally in the larger, better-quality timber while the bulk of the increment is in the younger, smaller, and less valuable trees. At present, therefore, the saw-timber stands are decreasing both in quantity and quality but the excess of increment over drain in the under-sawlog-size stand augurs well for the long-time future of the forest resource if over-cutting can be avoided during the years in which these young stands are growing to maturity. It is true that some of the trees in these young stands are of inferior species, some have been injured by fire, and many are defective because of rot. In general, however, these young stands will develop into a satisfactory source of saw timber, given fire protection, a reasonable amount of cultural treatment, and protection from premature cutting. It is encouraging to find that on some cutover areas the proportion of desirable species such as yellowpoplar is greater than in the original stands.

THE FORESTS AND ECONOMIC IMPROVEMENT

Within the mountain region of North Carolina many social, economic, and industrial problems are related directly or indirectly to the forest resource. Because of the complexity of our modern life there is no clear-cut dividing line between these problems but in the aggregate they present a maladjustment between population and opportunity for income.

There are several reasons for this situation. Primarily, there is a very high birth rate -- 50 percent above the average for the nation. Among the rural people there are close family ties and migration to other regions is largely by the more progressive individuals, who can be spared least from their communities. The time honored custom of dividing the family farm among the children has resulted in a great number of farms too small to adequately support a family. Topography and soil place rather definite limits upon the amount of land that can be used for cultivated crops and the efforts to arbitrarily exceed these limits have caused extensive depletion of the soil resource.

The forest resource has likewise been badly treated. Because of their pressing need for income the small land-owners have liquidated a large part of the timber values in their woodlands. On the commercial forest land logging has been in progress for about one-half century. Constantly decreasing quality standards have made it possible to log a large part of the area several times, each time with a more inclusive cut and with less growing stock left standing. In the past, forest fires were common and the effects are seen in many fire-scarred, rotten stems that are a liability in the growing stock. Conditions are not greatly different on most of the publicly owned land, because the damage was done before the title was acquired by public agencies. In effect, the forest of the region has been so heavily cut, culled and burned that its productivity has been greatly reduced. Many years will elapse before it can be restored.

In a realistic approach to the problem of developing better social and economic conditions in this region, it must be recognized that the forest, as a timber-producing resource, will play a comparatively minor role for at least several decades. Even with its present limitations, however, the forest is a necessary adjunct to several of the most important enterprises in the region. Most conspicuous is the part the forest plays in the support of the tourist and recreation industry. The beautiful wooded mountains with their flowering shrubs, clear trout streams, and wild game have a definite cash value to the local people. Many towns and rural homes obtain a large part of their income through the sale of food, lodging, farm produce, and mountain handicraft to visitors who come to enjoy the recreational advantages.

The topography and rainfall are conducive to the development of hydro-electric power. The forest serves in the regulation of stream flow and the prevention of erosion on the watersheds of developed streams. In addition to influencing power development, the forest watersheds of the region are a direct source of water for several of the largest industrial plants. The value of the forest in relation to hydro-electric power and industrial water supply may exceed its value as a potential producer of raw material for industry.

While the benefit of a greater timber supply should not be underestimated it seems probable that the most immediate improvement in the standard of living can be obtained through the establishment of more large manufacturing plants that would draw raw material from other regions. A recently established example is the cigarette-paper plant of the Ecusta Paper Corporation which obtains water from the Pisgah National Forest and flax from Minnesota, California, and North Dakota. As originally constructed this plant employed almost 1,000 workmen but when proposed expansions are completed a much larger number will be needed.

The beneficial effect of such plants upon employment and income opportunities are obvious, but sound planning of regional development on a long-time basis cannot afford to neglect the local natural resources that use local labor in both their production and manufacture. It is important to remember that the mountain forests can be used for timber production without seriously interfering with their functions of recreation, stream control, and water supply.

At present the yield of merchantable wood from the forest is small because of the large area stocked with small timber, the high proportion of cull volume in the stand, and the small amount of growing stock per acre. Increasing the yield is primarily a matter of time and fire protection, for about one-half of the area supports trees that must grow from a few years to several decades before they reach saw-timber size. During this time, they and the existing saw-timber stands should receive the intensive fire protection now accorded most of the forest area by the State and Federal fire protection organizations. The forest growing stock would also develop faster if the annual cut were reduced for the next decade but in this respect the immediate needs of the people and industries must be balanced against the needs of the forest. Even without a reduction in cut it is possible to improve the growing stock. On some favorably located operations a greater proportion of the cut can be obtained from thinnings and improvement cuttings in those species which can be handled without loss. In certain localities the utilization of sound, dead chestnut instead of small growing saw timber might afford the needed income for a few years. The conservative use of portable sawmills would facilitate the removal of low-grade material on many areas inoperable for band mills. Farmers, who own almost one-half the forest land, can improve their woodlands by utilizing more cull trees for fuelwood. Developing new plants to use hardwood pieces in short lengths and small diameters would also provide a market for some of the low-grade wood now considered cull material. In brief, there should be a constant effort to improve and protect the forest while the young stands are developing. At the same time the wood-using industries should follow a policy of conservative cutting to prevent further depletion of the saw-timber growing stock. When put into practice by farmers, commercial operators, and public agencies these measures will help to develop a greater and more valuable forest resource, capable of making a permanent and significant contribution to the social and economic welfare of the mountain people.

REVIEW OF THE REPORT

In the rugged mountain region of Western North Carolina the opportunities for obtaining an adequate income are limited. A majority of the people are engaged in agriculture, but because of population density and topographical limitations many of the farms are too small to provide a comfortable living. Although large industrial plants are operating in several counties, only one-fifth of all the people employed are engaged in manufacturing. The tourist trade is an important source of income throughout the region. About 600 primary wood-using plants utilize the timber resource.

Exclusive of the Great Smoky Mountains National Park, forests occupy 3.6 million acres, two-thirds of the land in the region. As a group, oak species predominate but sound dead chestnut and shortleaf pine are the two most abundant species. Hardwood types occupy 70 percent of the forest land and pine types 30 percent. Almost 90 percent of the land supports second-growth timber and 53 percent of the total forest area is stocked with under-sawlog-size stands. Nine-tenths of the forest land is in a fair to good timber-growing site.

The total saw-timber volume is nearly six billion board feet, about one-third softwoods and two-thirds hardwoods. Including usable chestnut there are about 50 million standard cords of all sound wood with bark. Excluding chestnut and the bark of all species, there are 2.6 billion cubic feet of wood.

Increment amounted to 253 million board feet, 1.4 million cords, or 93 million cubic feet. The average annual increment per acre was only 72 board feet of saw timber, or four-tenths of a cord of all sound material.

About 600 primary forest products plants operated in the mountain region in 1938. A variety of plants were represented, including 570 sawmills, 11 dimension stock mills, 8 extract plants, 6 shuttle block mills, 5 veneer plants, 2 pulp mills, and other plants making cooperage, excelsior, and insulator pins. The sawmills produced 247 million board feet of lumber in 1937 and 193 million board feet in 1938. About 787,000 cords of fuelwood were cut. In both woods and mills the forest resource provided 2.3 million man-days of employment to about 12,000 workmen.

The total commodity drain upon the forest was 252 million board feet of saw timber or 66 million cubic feet of all sound material. The softwood growing stock increased by seven million board feet in 1938 and the hardwood decreased by the same amount. The total stand increased by 27 million cubic feet, equivalent to 464,000 cords.

The forest resource is so depleted that yields of wood will remain low for many years. Consequently there is little opportunity for any immediate expansion in the wood-using industries and it is probable that some of the larger sawmills will soon cease operating. The relation of the forest to recreation, stream control, and water supply is important, but the mountain forests can be used for these functions without interfering with their use for timber production. In the next few decades the yield of timber can be greatly increased if there is a constant effort to improve and protect the young timber while it is developing and a conservative cutting policy is practiced in the saw-timber stands.

GLOSSARY

General

Forest Survey Unit. -- The term "forest survey unit" denotes an area of 4 to 10 million acres in which topographic, forest, economic, and industrial conditions are reasonably homogeneous.

Land-use Classes

Productive forest area. -- Forest land having qualities essential for the growth of commercial timber.

Nonproductive forest area. -- Forest land lacking qualities essential for the growth of commercial timber.

Cropland, old and new. -- Land used for production of farm or orchard crops or evidently so used during the past 5 years. This includes new cropland, i.e., land converted from forest to cropland within 5 years prior to survey.

Pasture. -- Cleared or open land under fence used primarily for grazing.

Abandoned cropland. -- Land once cultivated but showing distinct evidence of having been abandoned for agricultural crop production.

Other non-forest. -- Areas included within the corporate limits and surburban or industrial sections of cities and communities; power, rail, and highway rights-of-way; marsh; and nonmeandered waterways.

Forest Types

Upland hardwoods. -- Stands in which mixed oaks, chestnut, and other hardwoods make up 75 percent or more of the dominant and codominant stems found throughout the mountain region.

Cove hardwoods. -- Stands in which yellowpoplar, cucumber, red maple, white ash, black birch, buckeye, and basswood make up 75 percent or more of the dominant and codominant stems, usually found on lower north slopes and in coves along small streams.

Shortleaf pine-hardwoods. -- Stands in which pines make up 25 percent or more of the dominant and codominant stems with shortleaf pine predominating. Includes stands of table mountain and pitch pine.

White pine-hardwoods. -- Stands in which pines make up 25 percent or more of the dominant and codominant stems with white pine predominating. Includes stands of hemlock, red spruce, and Fraser fir.

Virginia pine-hardwoods. -- Stands in which pines make up 25 percent or more of the dominant and codominant stems with Virginia pine predominating.

Diameters

D.b.h. (diameter at breast height). -- Diameter, outside of bark, measured at 4½ feet from the ground.

Diameter class. -- All trees were recorded in 2-inch diameter classes, including diameters 1.0 inch below and 0.9 above the stated midpoint, e.g., trees 7.0 to 8.9 inches d.b.h. are placed in the 8-inch class.

Tree Classification

Sound sawlog-size tree. -- A pine tree at least 9.0 inches d.b.h., a yellowpoplar, basswood, ash, cherry, or walnut tree at least 11.0 inches d.b.h. and other hardwood trees at least 13.0 inches d.b.h., with not less than one sound butt log 12 feet long, or with 50 percent of the gross volume of the tree in sound saw timber.

Sound under-sawlog-size tree. -- Any tree over 1.0 inch d.b.h. and less than sawlog-size, with a reasonably straight sound stem.

Cull tree. -- Any tree that fails to qualify as a sound sawlog or under-sawlog-size tree because of form, limbiness, rot, or other defect.

Forest Conditions

Sawlog Size

Old growth, uncut. -- Stands composed of trees having the characteristics of the original mature timber of the region and containing at least 1,000 board feet per acre of merchantable species in hardwood types, and 600 board feet per acre in pine types, with less than 10 percent of the volume cut.

Old growth, partly cut. -- Old-growth stands from which 10 percent or more of the volume has been cut, leaving a minimum of 1,000 board feet per acre in the hardwood types, or 600 board feet per acre in the pine types.

Second growth, uncut. -- Stands of second growth having at least 600 board feet per acre in trees of sawlog-size, and with less than 10 percent of the sawlog-size trees removed.

Second growth, partly cut. -- Stands of second growth from which 10 percent or more of the sawlog-size trees have been removed but with the remaining stand containing 600 or more board feet per acre.

Under Sawlog Size

Second growth. -- Young second-growth stands in which the volume of timber in trees of sawlog size is less than 600 board feet per acre and the remainder of the trees are below sawlog size.

Reproduction. -- Stands too young to classify as second growth having at least 80 well distributed seedlings per acre.

Clear-cut. -- Cut-over areas having insufficient young growth to qualify either as second growth or reproduction.

Volume Estimates

Board-foot volume. -- Only the saw-timber portion of sawlog-size trees are included in this estimate. Top diameters vary with the limits of usable material. Deductions are made for woods cull and for loss in sawing at the mill.

Cordwood volume. -- This volume (including bark) is derived from the following sources:

1. The sawlog portion of sawlog-size trees.
2. The portion of saw-timber trees not usable as sawlogs but acceptable as cordwood. This includes the upper stems of pine and cedar and, unless otherwise noted, the upper stems and limbs of hardwoods The minimum diameter limit is 4.0 inches outside bark.
3. The full stem of sound under-sawlog-size trees, at least 5.0 inches d.b.h., to a variable top diameter not less than 4.0 inches outside bark.
4. The estimated sound material in cull trees.

Deductions for cull include only the volume in defects which cause the material to be unsuited for cordwood. Sweep and slight crook are not regarded as defects.

Cubic-foot volume. -- This volume is derived from the same sources as the cordwood volume except that bark is not included.

Standard cord. -- A stacked pile of round or split wood bolts measuring 4' x 4' x 8' and estimated to contain 90 cubic feet of wood and bark in the pine and cedar species, and 80 cubic feet of wood and bark in the hardwood species.

Increment

Growing stock. -- The sum of the volumes of all sound trees 5.0 inches d.b.h. and larger; dead and cull trees and tops of hardwood not included.

Board-foot increment. -- Includes the net growth on the saw-timber portion of sawlog-size trees, plus the volume in sound trees reaching sawlog-size.

Cordwood increment. -- Includes the net growth on the sound stemwood of pines and cedar 5.0 inches d.b.h. and over, on under sawlog-size hardwoods, and on the sawlog portion of sawlog-size hardwoods, plus the sound-tree volume of all species reaching 5.0 inches d.b.h. during the increment period.

Cubic-foot increment. -- Omits bark volumes, otherwise material is identical with cordwood.

Mortality

Mortality. -- The volume lost from the growing stock of the forest through the death of individual trees. Natural causes of mortality include lightning, tree competition, old age, disease, insects, drought, and wind. Fire is the major man-caused source of mortality.

Site Quality

Good site. -- Land representing the best growing conditions in the region usually located in coves, along streams, and on the lower north and east slopes. Stands composed of desirable species of good form. Mature dominant yellowpoplar trees on this site will average four or more 16-foot logs per tree, other hardwoods three or more logs, shortleaf pine four or more logs, and white pine and hemlock five or more.

Fair site. -- Land representing average growing conditions in the region, usually found on the lower south and west slopes and upper north and east slopes. Mature dominant yellowpoplar trees on this site will average two to four 16-foot logs per tree, other hardwoods one and one-half to three logs, shortleaf pine two to four logs, and white pine and hemlock three to five logs.

Poor site. -- Land representing below average growing conditions usually located on upper south and west slopes and dry ridge tops where soil depth and moisture are deficient. Rock outcrops are frequent and the soil contains numerous rock fragments. This site excludes land incapable of growing commercial timber, which is classified as nonproductive forest land (table 2). Mature hardwood trees will average about one 16-foot log per tree, shortleaf pine less than two logs and white pine and hemlock less than three logs.

Hardwood Log Grades. - Applicable to yellowpoplar, basswood, maple, black cherry, ash, northern red oak, white oak, chestnut oak, red oaks, birch, beech, hickory.

Log grade	Minimum length of log	Minimum diameter at small end of log	Allowable proportion of gross scale in defects*	Surface requirements		
				Proportion of 3 visible faces that must be clear	Allowable number of cuttings	Minimum length of cuttings
	Feet	Inches	Percent	Percent	Number	Feet
No. 1 (butt logs)	10	12**	25	80	1	8
No. 1	10	16	40	80	2	5
No. 2	8	12	40	66	2	4
No. 2	12	10	40	66	3	4
No. 3	10	8	40	50	No. limit	3
No. 3	10	11	50	40	No. limit	3

*If the total permissible defect is represented by sweep, the log should be degraded one grade. Mineral stain or blackheart permissible in not over one-half of the diameter. More than this will degrade the log. If the blackheart or mineral stain will not produce high grade No. 3 common lumber, it should be scaled out.

**Applies to sugar maple, basswood, cherry, ash, and northern red oak, all other hardwoods must be two inches larger to qualify as No. 1 logs. Worm holes not permitted in any No. 1 logs.

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FOREST SURVEY RELEASE NO. 8 MAY 15, 1941

THE DISTRIBUTION OF COMMERCIAL FOREST TREES IN NORTH CAROLINA

by

E. V. Roberts, Regional Survey Director
and
J. W. Cruikshank, Associate Forest Economist

A FOREST SURVEY PROGRESS REPORT

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

Appalachian Forest Experiment Station
R. E. McArdle, Director
Asheville, N. C.

PREFACE

Through the McSweeny-McNary Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act, and each of the 12 Regional Forest Experiment Stations is responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station, Asheville, North Carolina.

The work of the Survey is divided into 5 major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of the timber on these lands.

2. Growth. Determination of the current rate of timber growth.

3. Drain. Determination of the amount of industrial and domestic wood use, and the total loss resulting from fire, insects, disease, suppression, and other causes.

4. Requirements. Determination of the current and probable future requirements for forest products by all classes of consumers.

5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis for public and private policies and plans of forest land use and management.

This progress report presents information on one part of the inventory phase of the Survey and deals specifically with the geographic distribution of the more important commercial forest trees in North Carolina.

The report is made possible through the assistance received from the personnel of the Work Projects Administration. Particular credit is due Mr. W. H. Winston and Mr. Harry Watkins of the Work Projects staff. The preparation of the maps from the basic field data were official projects 765-32-3-3 and 165-2-32-94

Assisting Survey Staff

G. E. Morrill) Preparation of
T. C. Evans) Tables of Volume

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THE DISTRIBUTION OF COMMERCIAL FOREST TREES IN NORTH CAROLINA

PURPOSE OF REPORT

The geographic distribution of the species of forest trees and their sizes is of considerable economic importance to the wood-using industries. The ordinary forest type maps are valuable for many purposes but for industrial use maps are needed which show where certain species and tree sizes are most abundant. Established plants must know the location of areas with suitable timber supplies and prospective wood-using industries need the same information as an aid in selecting desirable locations.

The maps included in this report are designed to provide more definite information regarding the location of forest tree species in North Carolina. They show where selected species of commercial importance occur and, what is more important from an industrial standpoint, the areas of dense concentration. Forest industries can thus avoid the expense of wide reconnaissance and can concentrate their wood procurement activities in the most favorable localities.

METHOD OF CONSTRUCTING MAPS

The sample plots established in 1937 and 1938 by the Forest Survey in the comprehensive inventory of the forest resources of North Carolina have been used in the construction of these maps. The plots were located at intervals of one-eighth of a mile on parallel compass lines 10 miles apart extending across each of the survey units into which the state was divided (fig. 1). The data recorded on each forest plot included a brief over-all description of the forest stand and a tally of the species, number, and size of all forest trees one inch and larger in diameter at breast height.

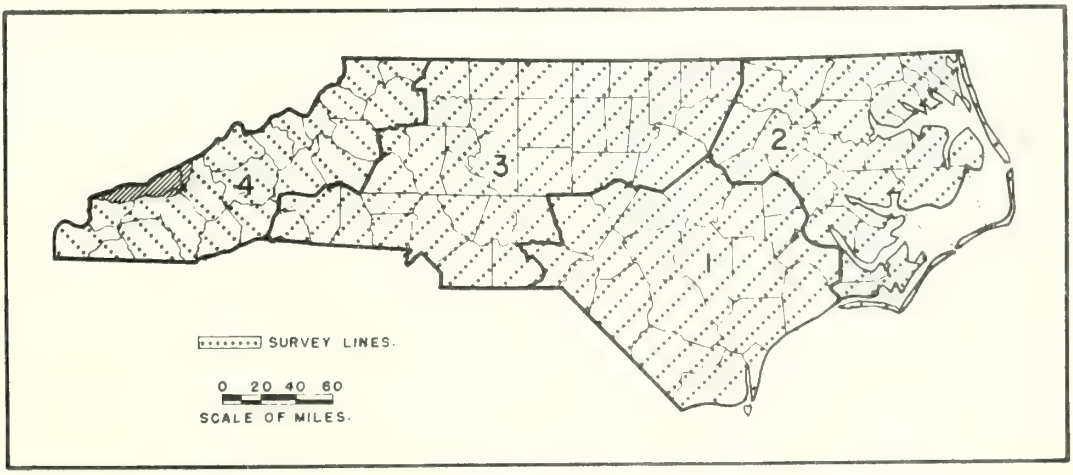

FIGURE 1 – APPROXIMATE LOCATION OF SURVEY LINES IN NORTH CAROLINA.

This procedure gave an accurate picture of the timber stand on each forest plot, but because of the necessity for using a sampling method rather than a 100 percent tally of all forest land, each plot represents about 800 acres of forest. Obviously many local concentrations of timber could not be sampled and the maps are therefore not reliable for locating timber on small ownerships. Nearly 38,000 uniformly distributed plots in North Carolina do provide, however, a dependable measure of the commercial concentration of certain species and sizes within counties.

On each map the total volume of sound trees is shown by diameter class for each unit and for the state. The volume of the under-sawlog-size trees is given in cords and the net volume of saw-timber material is given in board feet measured by the International $\frac{1}{4}$-inch rule, a close approximation of green lumber tally. In a few units the volume of certain species is insignificant and is not shown separately.

The accompanying maps are of two distinct kinds; those based upon forest types and those based upon species and diameter class. They are described as follows.

Maps Based on Forest Types

The maps showing the distribution of longleaf, loblolly, shortleaf, pond, and Virginia pines are based upon forest types. That is, every dot represents a forest plot on which the particular pine species is predominant. In the map showing the distribution of shortleaf pine in North Carolina, for example, each dot is a forest plot typed in the field as shortleaf pine. Other pine species may have been present upon the plot but not in sufficient quantity to influence the type classification. This method delineates the areas dominated by a particular pine species and is not intended to indicate the maximum range of the species.

Maps Based on Species and Diameter Class

The maps showing the distribution of white pine, redcedar, hemlock, cypress, red and white oaks, chestnut oak, chestnut, ash, hickory, sweetgum, blackgum and tupelo, yellowpoplar, and basswood are based on the occurrence of individual trees on the sample plots. For example, each dot on the maps showing the distribution of redcedar represents a plot on which there was at least one sound redcedar tree 8.0 inches or larger in diameter. On many of these plots there were undoubtedly several large redcedars. As every species is not plotted uniformly in regard to the number of individual trees per plot or size-class represented, the basis is given in the legend of each map. The distribution of oaks, gums, and yellowpoplar 18.0 inches d.b.h. and larger has been presented to facilitate industrial use of these premium sizes.

THE FORESTS OF NORTH CAROLINA[1]

Species

Forests occupy 18 million acres, 59 percent of the land area of the state. Loblolly pine is the most abundant species, dominating the forest over much of the Coastal Plain. Blackgum, tupelo, and pond pine are also important in many of the swamps of this area. Shortleaf pine is most common in the Piedmont of North Carolina although it is largely replaced by Virginia pine in that part of the Piedmont bordering the Blue Ridge. A great variety of species are found in the mountain region. Sound dead and dying chestnut has the greatest commercial volume of any single species in the mountains but yellowpoplar and several species of oaks are more important as a future source of sawtimber Throughout the state the hardwoods intermingle with the pines and altogether constitute nearly one-half of the total sound-tree volume.

Forest Types

The loblolly pine-hardwoods type is the most extensive, occupying 26 percent of the forested land in the state About 17 percent of the forest is in the shortleaf pine-hardwoods type. The third largest pine type is pond pine-hardwoods found on nearly two million acres in the Coastal Plain, 11 percent of the total forest land. Smaller in area are the longleaf pine-hardwoods, Virginia pine-hardwoods, and white pine-hardwoods types, which occupy respectively five, four, and two percent of the forest area.

Nearly four million acres of forest, 22 percent of the total, is classified as upland hardwoods. This broad classification covers a variety of hardwood species combinations but in general the hardwood forests of the Piedmont are an oak-hickory association and those of the mountains are oak-hickory and oak-chestnut. The bottomland hardwoods type is found chiefly in the large swamps and river over-flow basins of the Coastal Plain. It occurs on about 13 percent of the forest land.

Forest Conditions

The forests of the state are predominantly second growth. Old-growth stands occupy only 12 percent of the forest land, and many of them are small scattered tracts in themselves of limited commercial importance. The 7.5 million acres of second-growth sawtimber constitute 42 percent of the forest area. About eight million acres, 45 percent, are stocked with young second growth under-sawlog-size. The mountain region has the highest proportionate area stocked with these young stands. Less than two percent of the forest land is clear-cut and not restocking, practically all of it in the Coastal Plain.

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[1] A detailed description of North Carolina's forest resources and industries is presented in the Forest Survey Releases listed on page 4. Copies of these releases may be obtained by writing the Appalachian Forest Experiment Station, Asheville, North Carolina.

FOREST SURVEY RELEASES PERTAINING TO NORTH CAROLINA

Forest Resources of the Southern Coastal Plain of North Carolina.
Forest Survey Release No. 4, April 1, 1940. (Survey Unit No. 1).

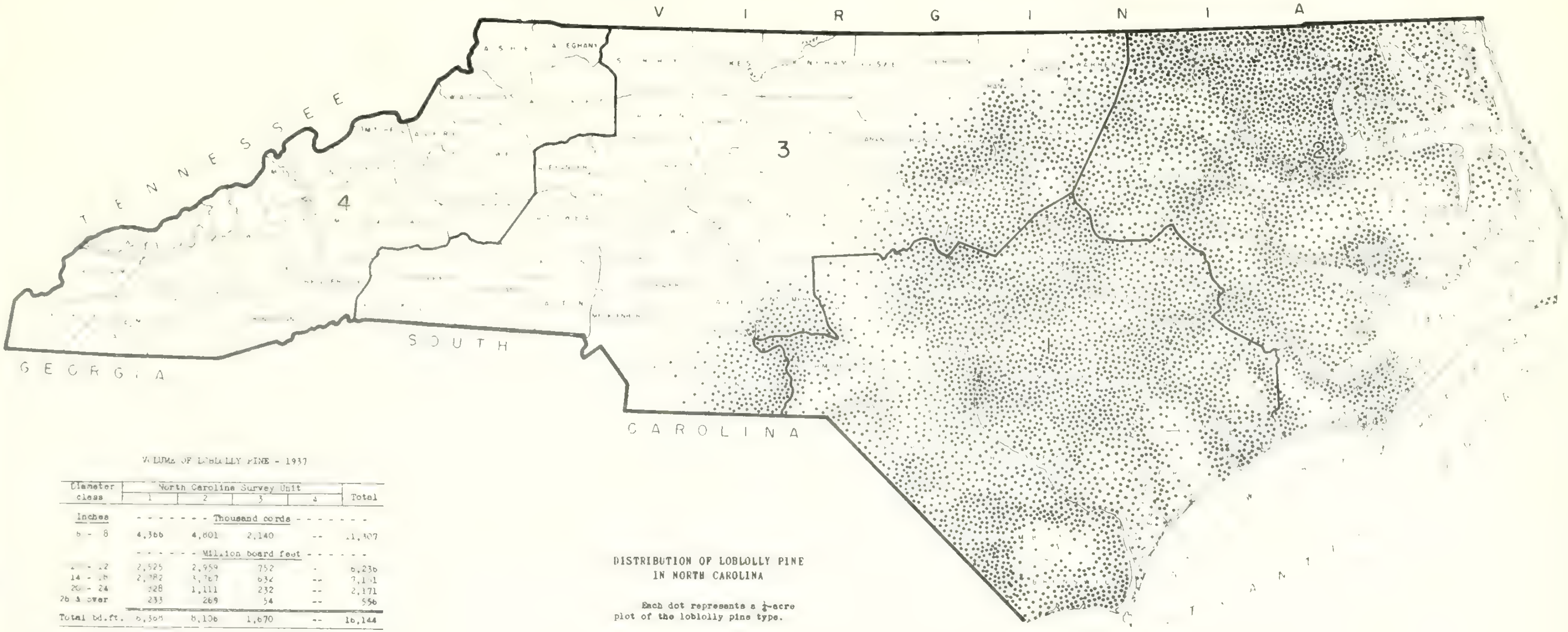
Forest Resources of the Northern Coastal Plain of North Carolina.
Forest Survey Release No. 5, June 15, 1940. (Survey Unit No. 2).

Forest Resources of the Piedmont Region of North Carolina.
Forest Survey Release No. 6, November 15, 1940. (Survey Unit No. 3).

Forest Resources of the Mountain Region of North Carolina.
Forest Survey Release No. 7, April 1, 1941. (Survey Unit No. 4).

DISTRIBUTION MAPS OF COMMERCIAL FOREST TREES

Map	Tree Species Included
Loblolly pine	- Loblolly pine
Shortleaf pine	- Shortleaf pine
Longleaf pine	- Longleaf pine
Pond pine	- Pond pine
Virginia pine	- Virginia pine
White pine	- Eastern white pine
Redcedar	- Eastern redcedar
Hemlock	- Eastern hemlock, Carolina hemlock
Cypress	- Baldcypress, pondcypress
Red oak	- Black, scarlet, water, willow, southern red, cherrybark, and northern red oak.
White oak	- White oak, swamp chestnut oak
Chestnut oak	- Chestnut oak
Chestnut	- American chestnut
Ash	- White, red, green, and Carolina ash
Hickory	- Bitternut, water, shagbark, mockernut, and pignut hickory.
Sweetgum	- Sweetgum
Blackgum	- Blackgum, water tupelo
Yellowpoplar	- Yellowpoplar
Basswood	- American, white, and Carolina basswood.



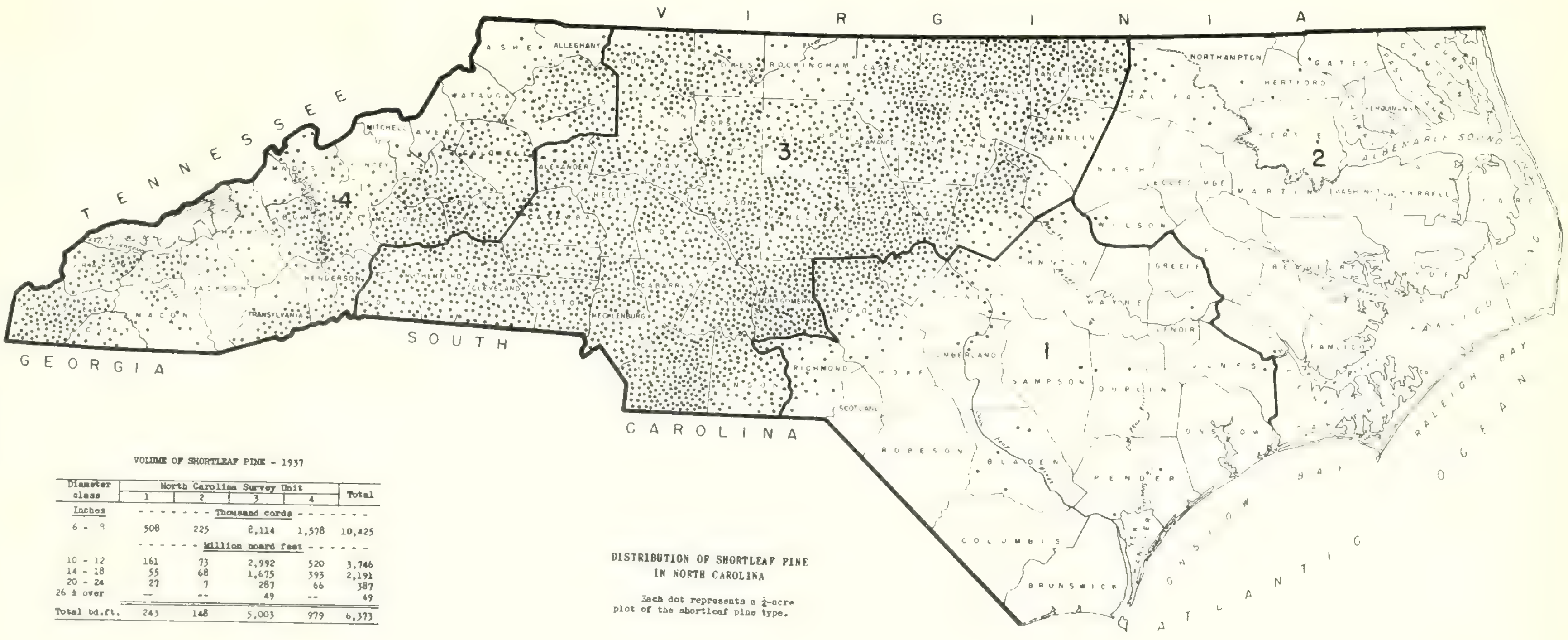
VOLUME OF LOBLOLLY PINE - 1937

Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches			Thousand cords		
6 - 8	4,366	4,801	2,140	--	11,307
			Million board feet		
10 - 12	2,525	2,959	752	-	6,236
14 - 18	2,782	3,767	632	--	7,181
20 - 24	828	1,111	232	--	2,171
26 & over	233	269	54	--	556
Total bd.ft.	6,368	8,106	1,670	--	16,144

DISTRIBUTION OF LOBLOLLY PINE
IN NORTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot of the loblolly pine type.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



VOLUME OF SHORTLEAF PINE - 1937

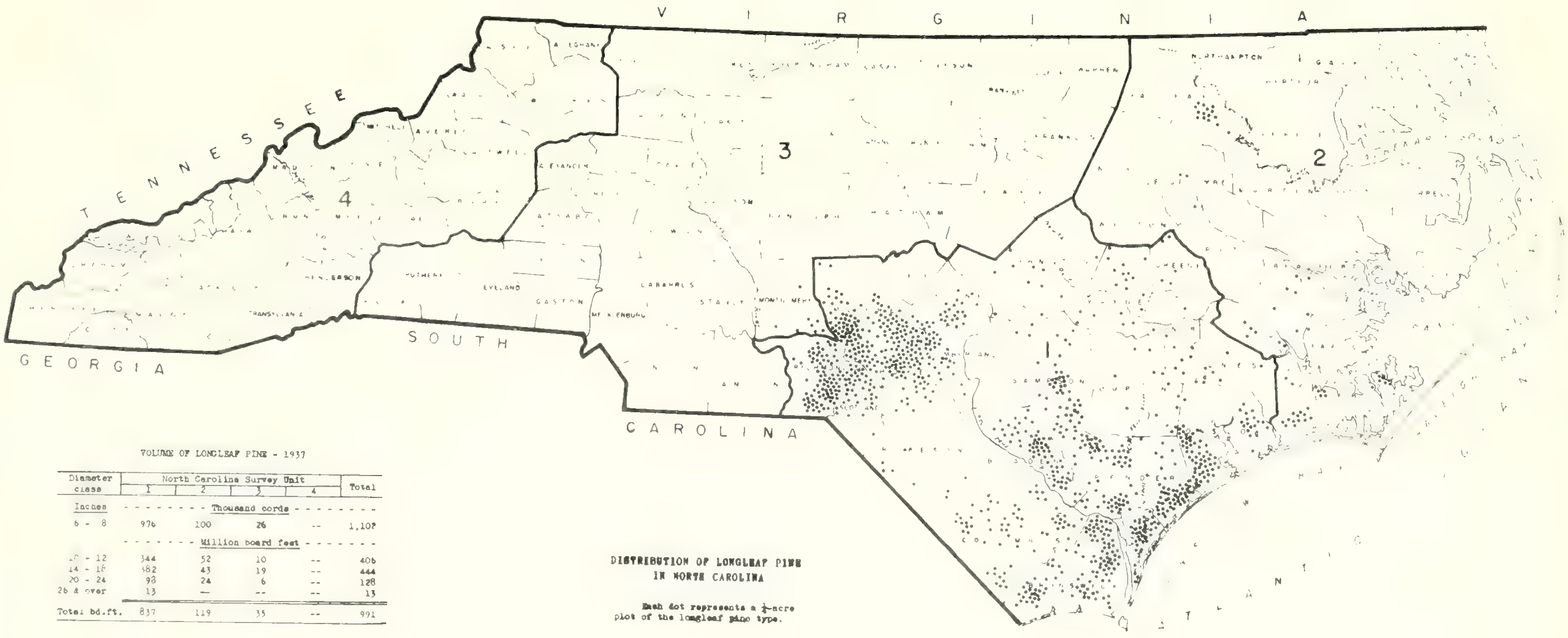
Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches	- - - - - - - -	Thousand cords	- - - - - - - -		
6 - 9	508	225	8,114	1,578	10,425
	- - - - - - -	Million board feet	- - - - - - -		
10 - 12	161	73	2,992	520	3,746
14 - 18	55	68	1,675	393	2,191
20 - 24	27	7	287	66	387
26 & over	--	--	49	--	49
Total bd.ft.	243	148	5,003	979	6,373

DISTRIBUTION OF SHORTLEAF PINE
IN NORTH CAROLINA

Each dot represents a ¼-acre plot of the shortleaf pine type.

NPB 12-2-40

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



VOLUME OF LONGLEAF PINE - 1937

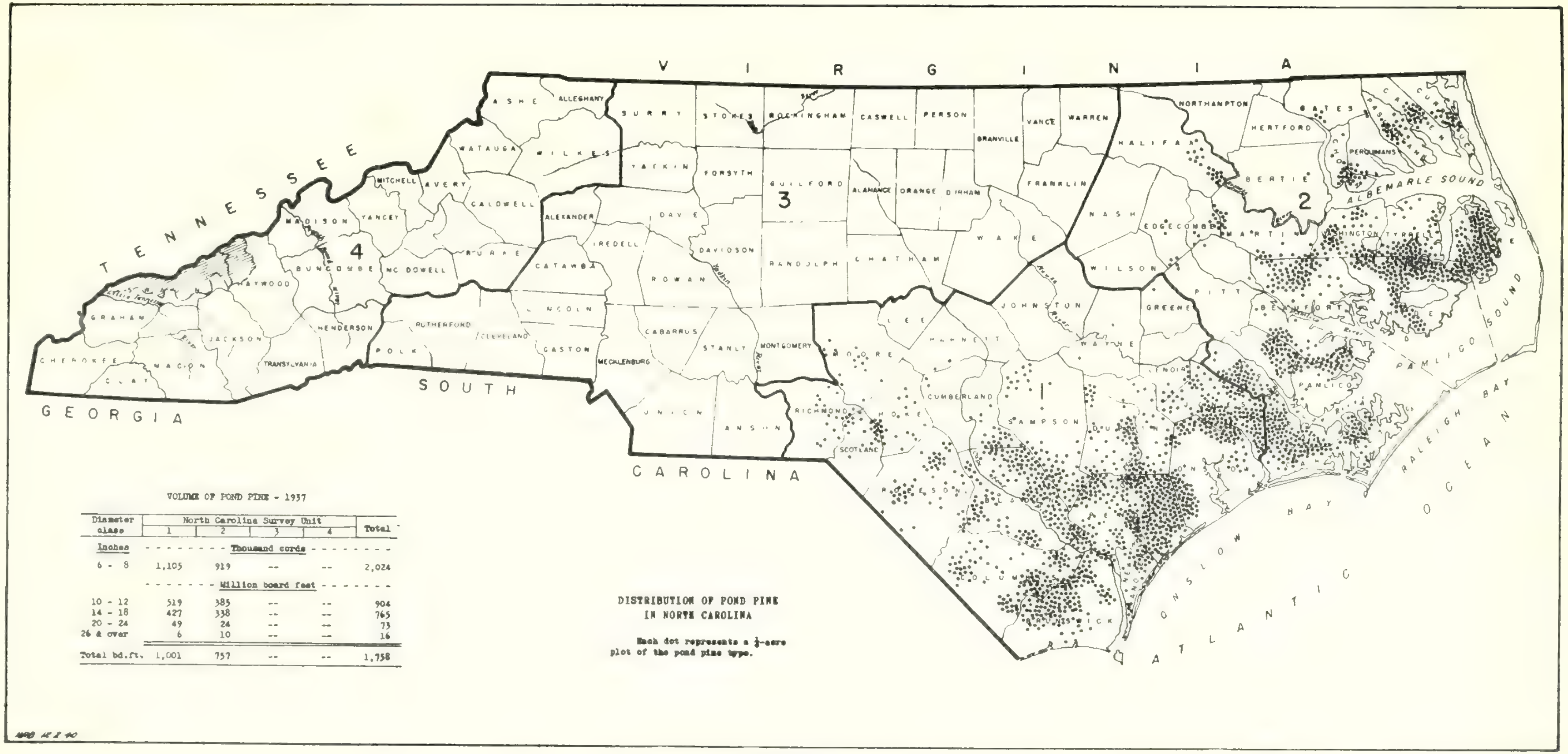
Diameter class	North Carolina Survey Unit 1	2	3	4	Total
Inches			Thousand cords		
6 - 8	976	100	26	--	1,102
			Million board feet		
10 - 12	344	52	10	--	406
14 - 18	382	43	19	--	444
20 - 24	98	24	6	--	128
26 & over	13	—	--	--	13
Total bd.ft.	837	119	35	--	991

DISTRIBUTION OF LONGLEAF PINE IN NORTH CAROLINA

Each dot represents a ½-acre plot of the longleaf pine type.

WPB 1-2-40

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



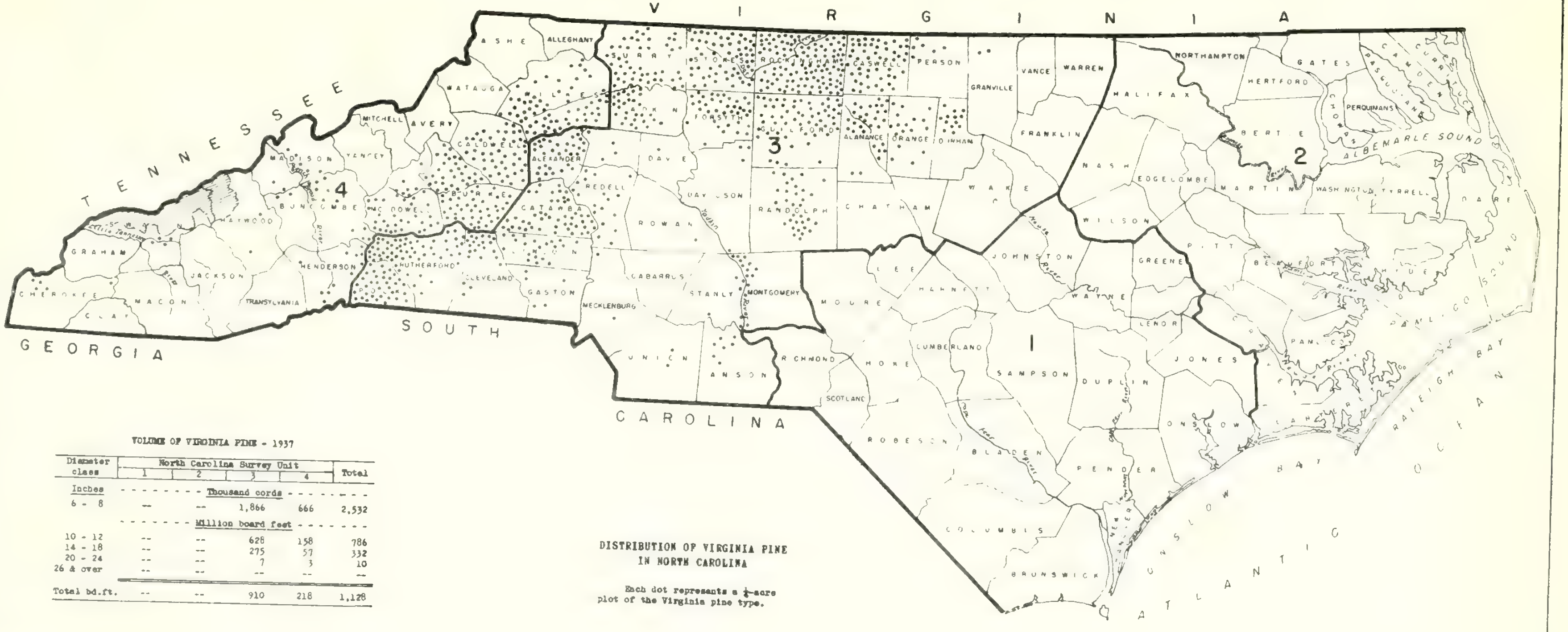
VOLUME OF POND PINE - 1937

Diameter class	North Carolina Survey Unit 1	2	3	4	Total
Inches			Thousand cords		
6 - 8	1,105	919	--	--	2,024
			Million board feet		
10 - 12	519	385	--	--	904
14 - 18	427	338	--	--	765
20 - 24	49	24	--	--	73
26 & over	6	10	--	--	16
Total bd.ft.	1,001	757	--	--	1,758

DISTRIBUTION OF POND PINE
IN NORTH CAROLINA

Each dot represents a ⅕-acre plot of the pond pine type.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



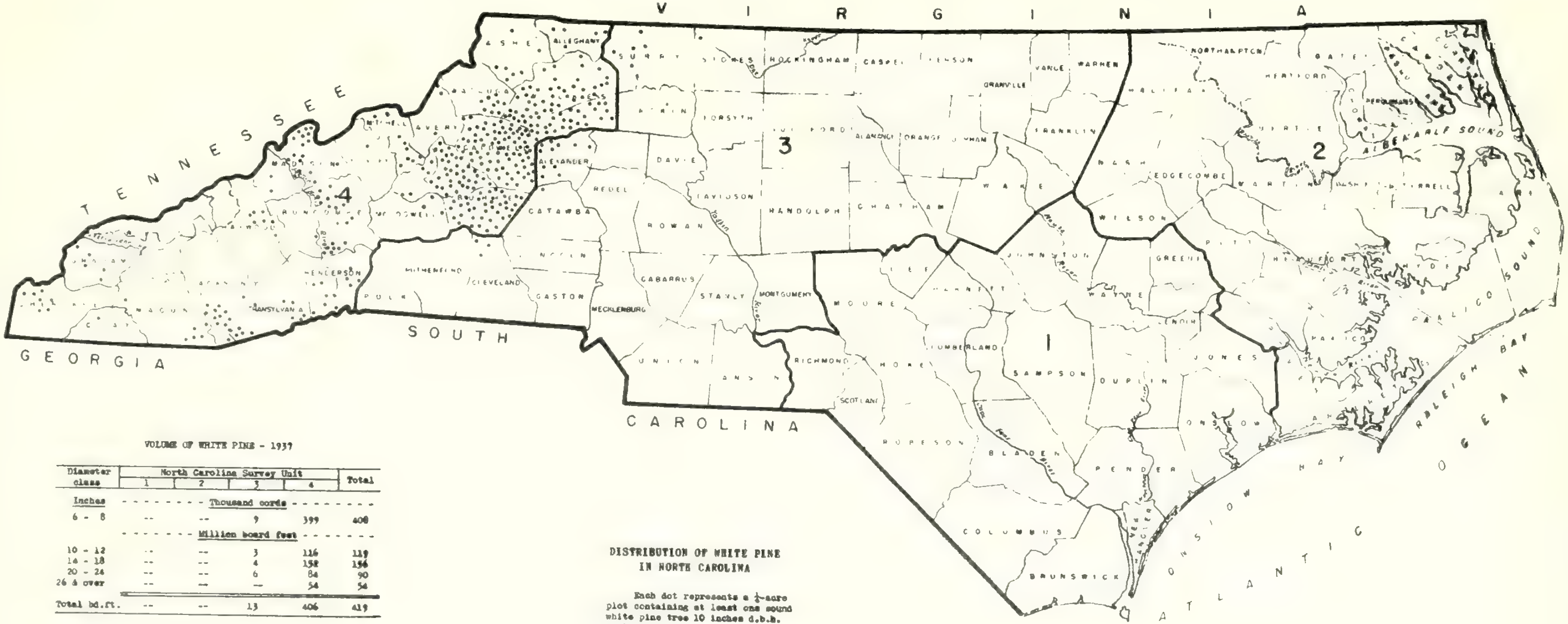
VOLUME OF VIRGINIA PINE - 1937

Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches	Thousand cords				
6 - 8	--	--	1,866	666	2,532
	Million board feet				
10 - 12	--	--	628	158	786
14 - 18	--	--	275	57	332
20 - 24	--	--	7	3	10
26 & over	--	--	--	--	--
Total bd.ft.	--	--	910	218	1,128

DISTRIBUTION OF VIRGINIA PINE
IN NORTH CAROLINA

Each dot represents a ¼-acre plot of the Virginia pine type.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



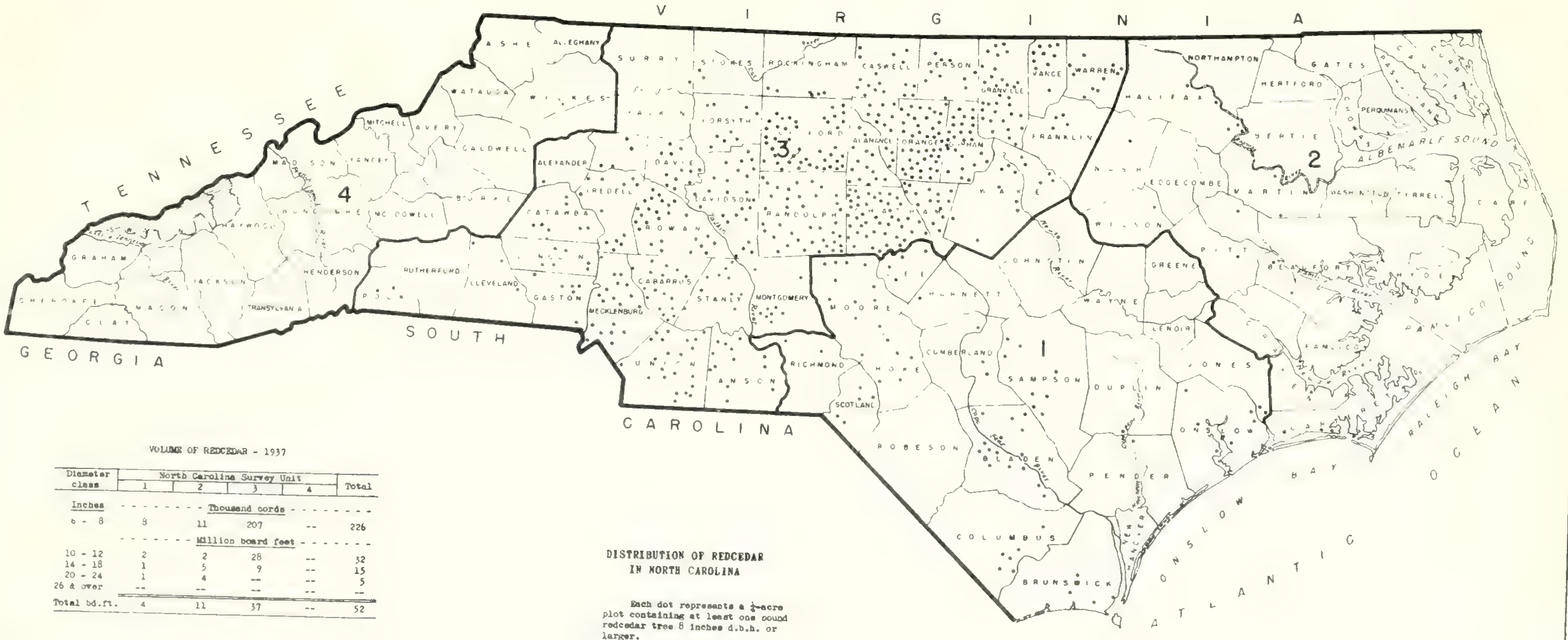
DISTRIBUTION OF WHITE PINE
IN NORTH CAROLINA

Each dot represents a ¼-acre plot containing at least one sound white pine tree 10 inches d.b.h. or larger.

VOLUME OF WHITE PINE - 1937

Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches			Thousand cords		
6 - 8	--	--	9	399	408
			Million board feet		
10 - 12	--	--	3	116	119
14 - 18	--	--	4	152	156
20 - 24	--	--	6	84	90
26 & over	--	--	--	54	54
Total bd.ft.	--	--	13	406	419

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



VOLUME OF REDCEDAR - 1937

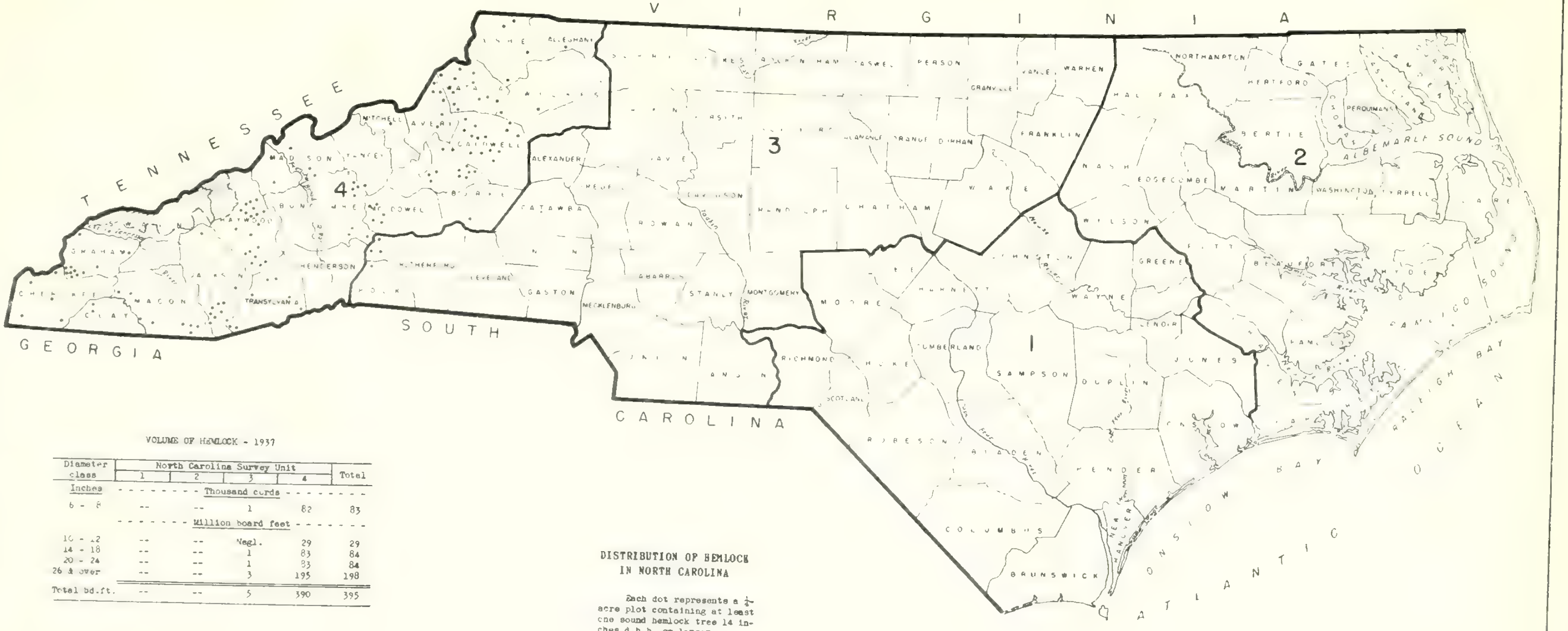
Diameter class	North Carolina Survey Unit 1	2	3	4	Total
Inches			Thousand cords		
6 - 8	8	11	207	--	226
			Million board feet		
10 - 12	2	2	28	--	32
14 - 18	1	5	9	--	15
20 - 24	1	4	--	--	5
26 & over	--	--	--	--	--
Total bd.ft.	4	11	37	--	52

DISTRIBUTION OF REDCEDAR
IN NORTH CAROLINA

Each dot represents a ¼-acre plot containing at least one sound redcedar tree 8 inches d.b.h. or larger.

HPB 12-2-40

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



VOLUME OF HEMLOCK - 1937

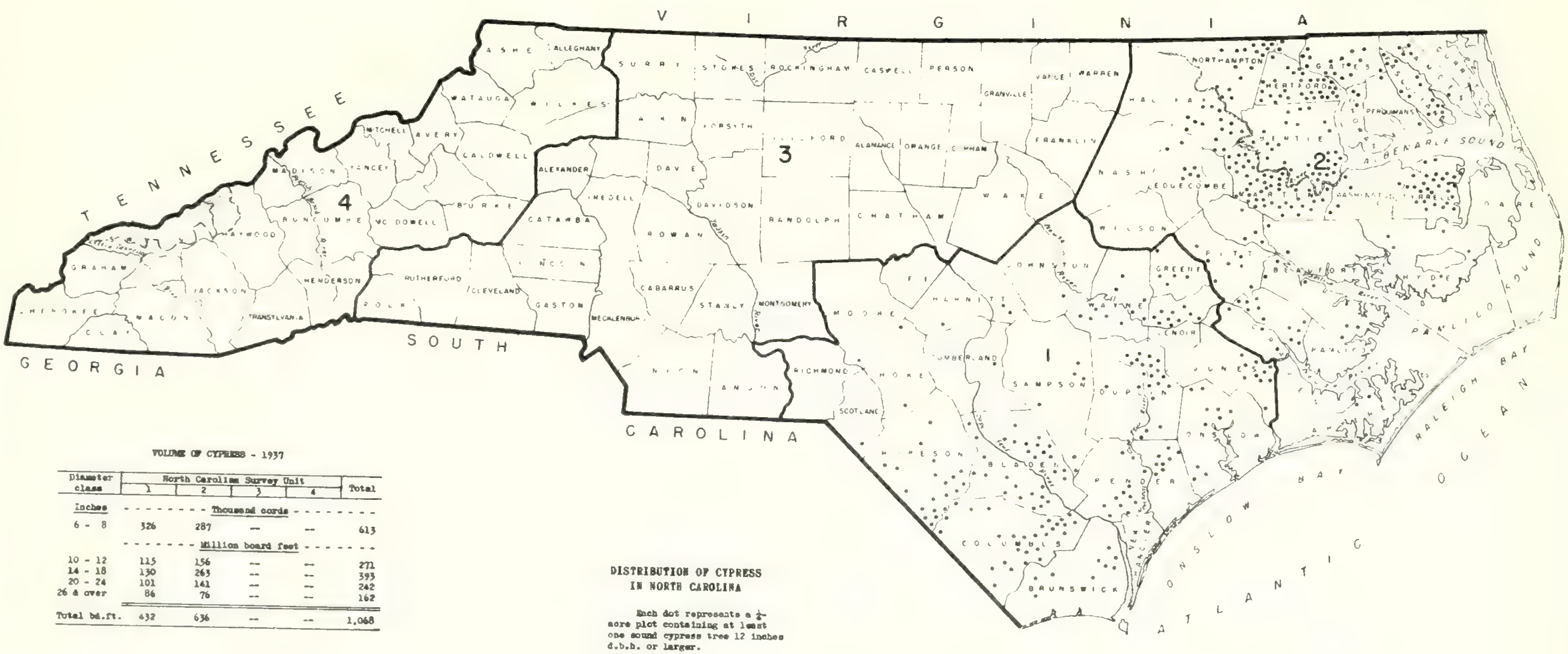
Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches	Thousand cords				
6 - 8	--	--	1	82	83
	Million board feet				
10 - 12	--	--	Negl.	29	29
14 - 18	--	--	1	83	84
20 - 24	--	--	1	83	84
26 & over	--	--	3	195	198
Total bd.ft.	--	--	5	390	395

DISTRIBUTION OF HEMLOCK
IN NORTH CAROLINA

Each dot represents a 1/4-acre plot containing at least one sound hemlock tree 14 inches d.b.h. or larger.

MPH 12-2-40

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



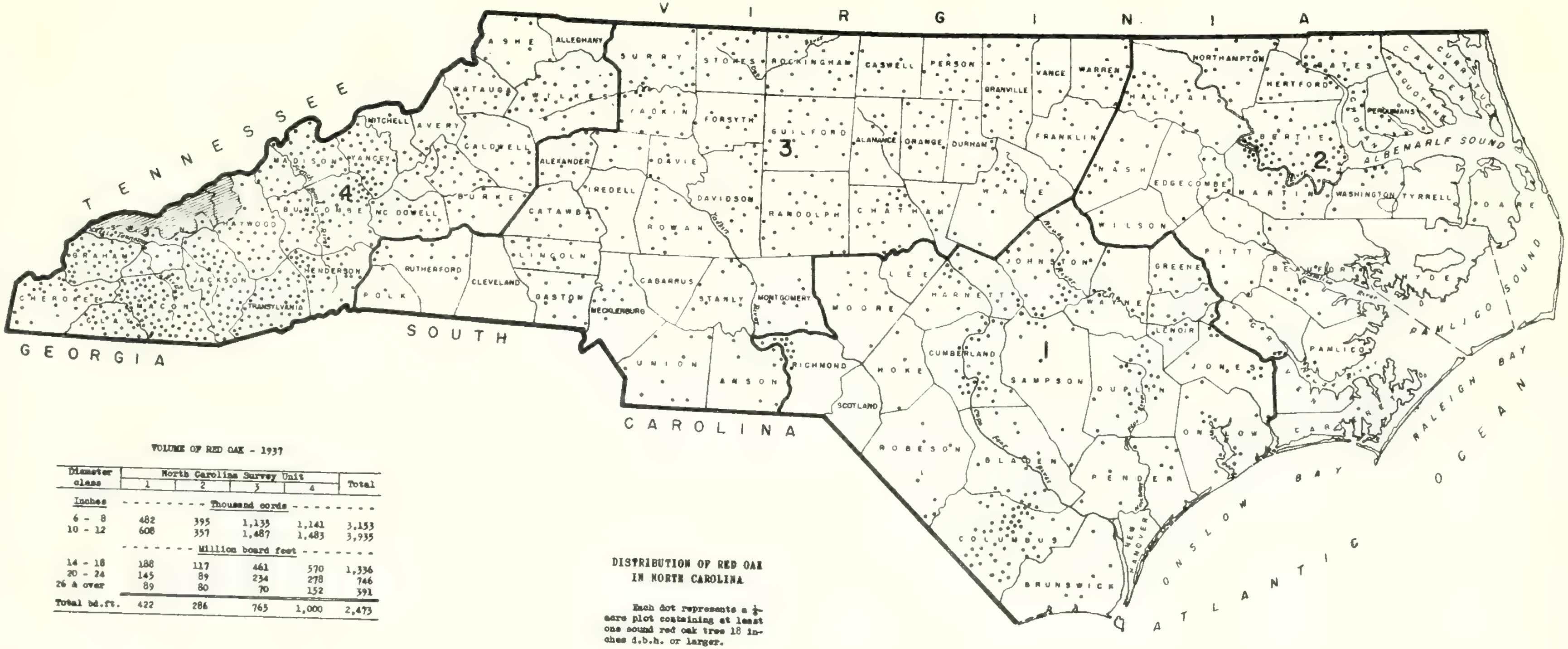
VOLUME OF CYPRESS - 1937

Diameter class	North Carolina Survey Unit 1	2	3	4	Total
Inches	Thousand cords				
6 - 8	326	287	--	--	613
	Million board feet				
10 - 12	115	156	--	--	271
14 - 18	130	263	--	--	393
20 - 24	101	141	--	--	242
26 & over	86	76	--	--	162
Total bd.ft.	432	636	--	--	1,068

DISTRIBUTION OF CYPRESS
IN NORTH CAROLINA

Each dot represents a ¼-acre plot containing at least one sound cypress tree 12 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



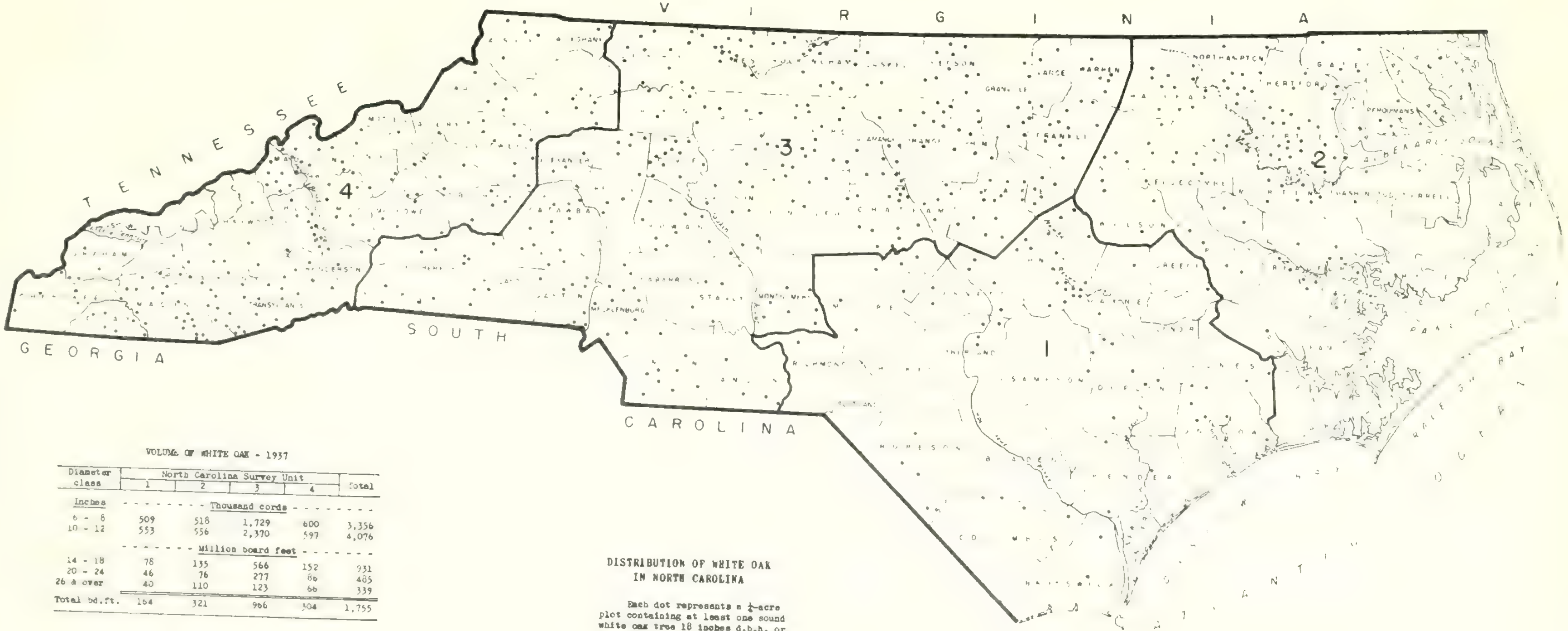
VOLUME OF RED OAK - 1937

Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches	- - - - - - - - - -	- - Thousand cords	- - - - - - - - - -		
6 - 8	482	395	1,135	1,141	3,153
10 - 12	608	357	1,487	1,483	3,935
	- - - - - - -	- Million board feet	- - - - - - -		
14 - 18	188	117	461	570	1,336
20 - 24	145	89	234	278	746
26 & over	89	80	70	152	391
Total bd.ft.	422	286	765	1,000	2,473

DISTRIBUTION OF RED OAK
IN NORTH CAROLINA

Each dot represents a ¼-acre plot containing at least one sound red oak tree 18 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



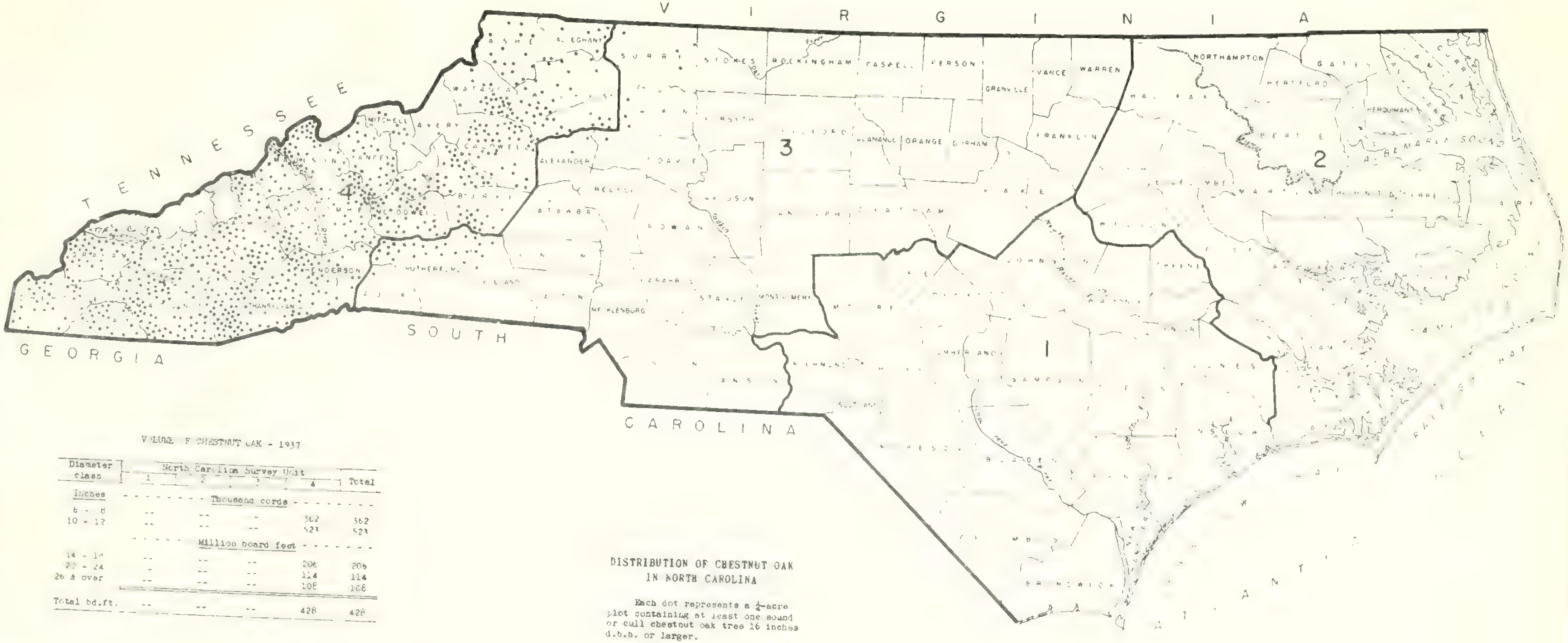
VOLUME OF WHITE OAK - 1937

Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches	- - - - - - - - Thousand cords - - - - - - - -				
6 - 8	509	518	1,729	600	3,356
10 - 12	553	556	2,370	597	4,076
	- - - - - - - - Million board feet - - - - - - - -				
14 - 18	78	135	566	152	931
20 - 24	46	76	277	86	485
26 & over	40	110	123	66	339
Total bd.ft.	164	321	966	304	1,755

DISTRIBUTION OF WHITE OAK
IN NORTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot containing at least one sound white oak tree 18 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



DISTRIBUTION OF CHESTNUT OAK
IN NORTH CAROLINA

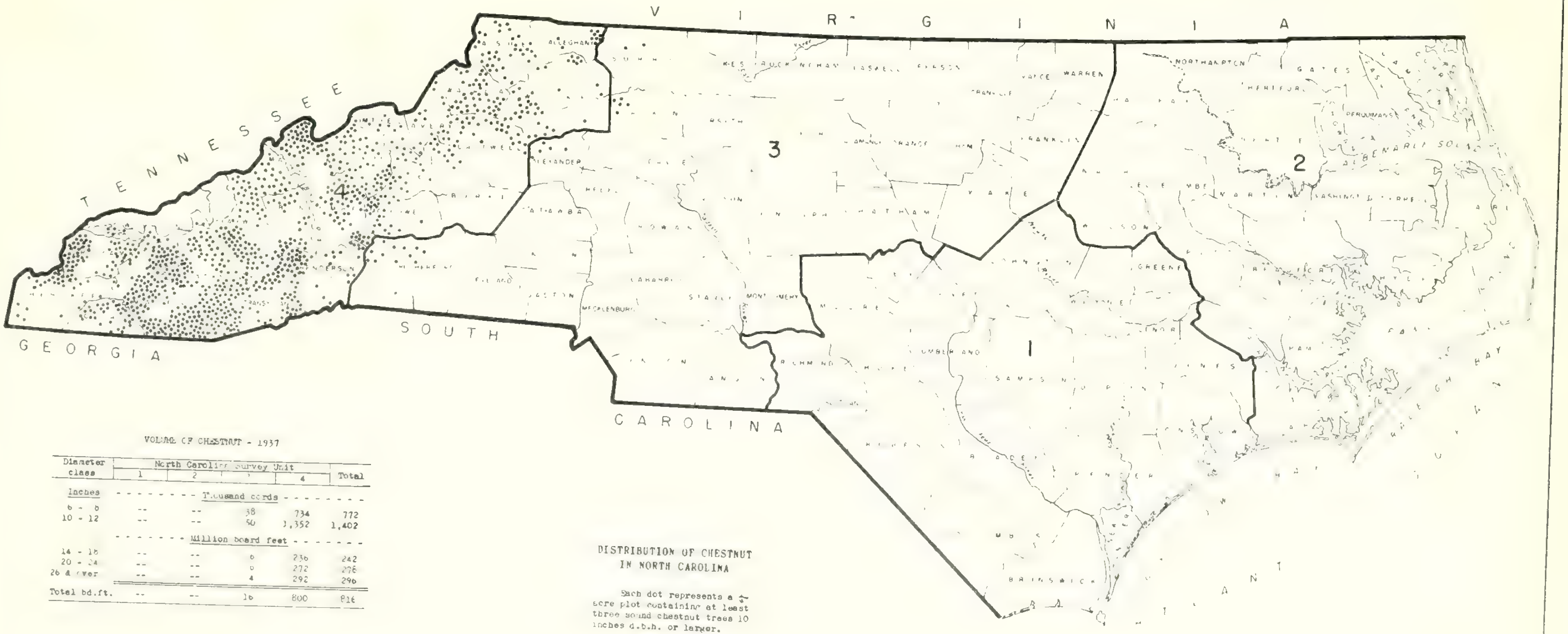
Each dot represents a ¼-acre plot containing at least one sound or cull chestnut oak tree 16 inches d.b.h. or larger.

VOLUME OF CHESTNUT OAK - 1937

Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches	Thousand cords				
6 - 8	--	--	--	362	362
10 - 12	--	--	--	523	523
	Million board feet				
14 - 18	--	--	--	206	206
20 - 24	--	--	--	114	114
26 & over	--	--	--	108	108
Total bd.ft.	--	--	--	428	428

NPB 12-2-40

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



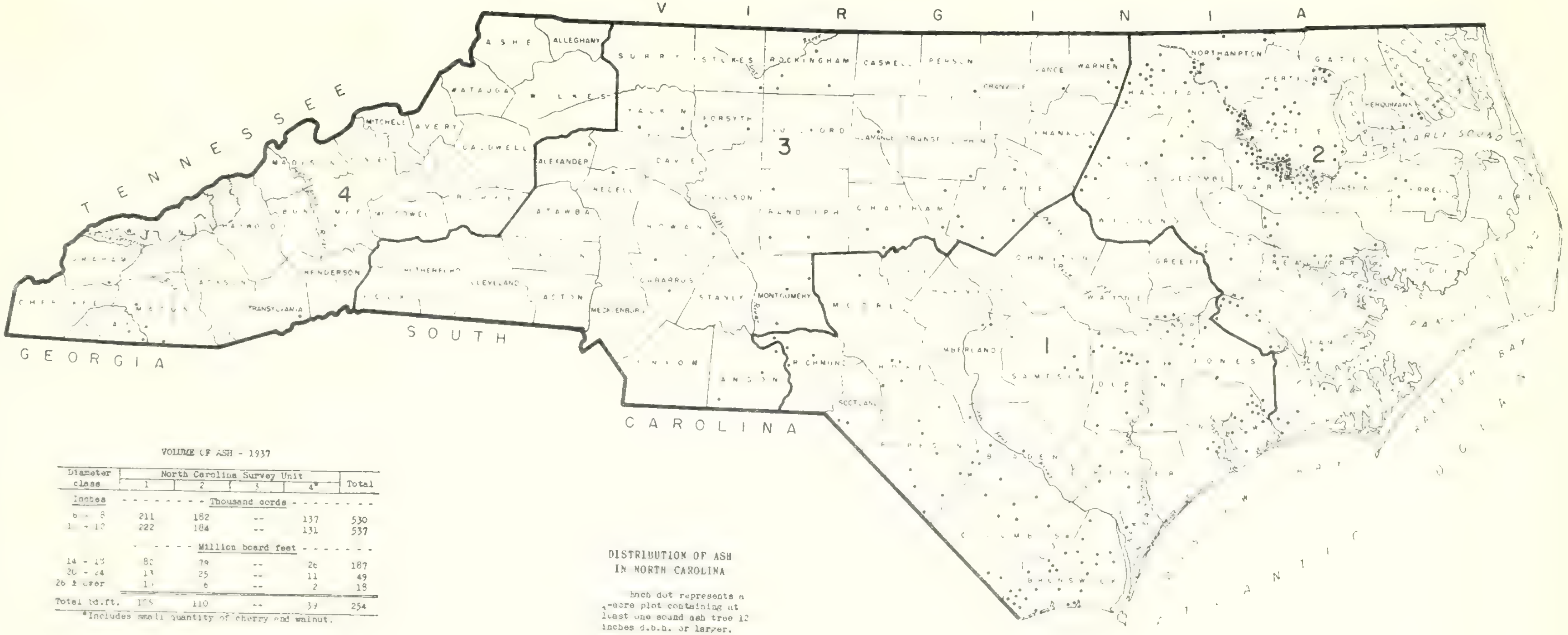
VOLUME OF CHESTNUT - 1937

Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches	- - - - - - - - - Thousand cords - - - - - - - - -				
6 - 8	--	--	38	734	772
10 - 12	--	--	50	1,352	1,402
	- - - - - - - Million board feet - - - - - - -				
14 - 18	--	--	6	236	242
20 - 24	--	--	6	272	278
26 & over	--	--	4	292	296
Total bd.ft.	--	--	16	800	816

DISTRIBUTION OF CHESTNUT
IN NORTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot containing at least three sound chestnut trees 10 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



VOLUME OF ASH - 1937

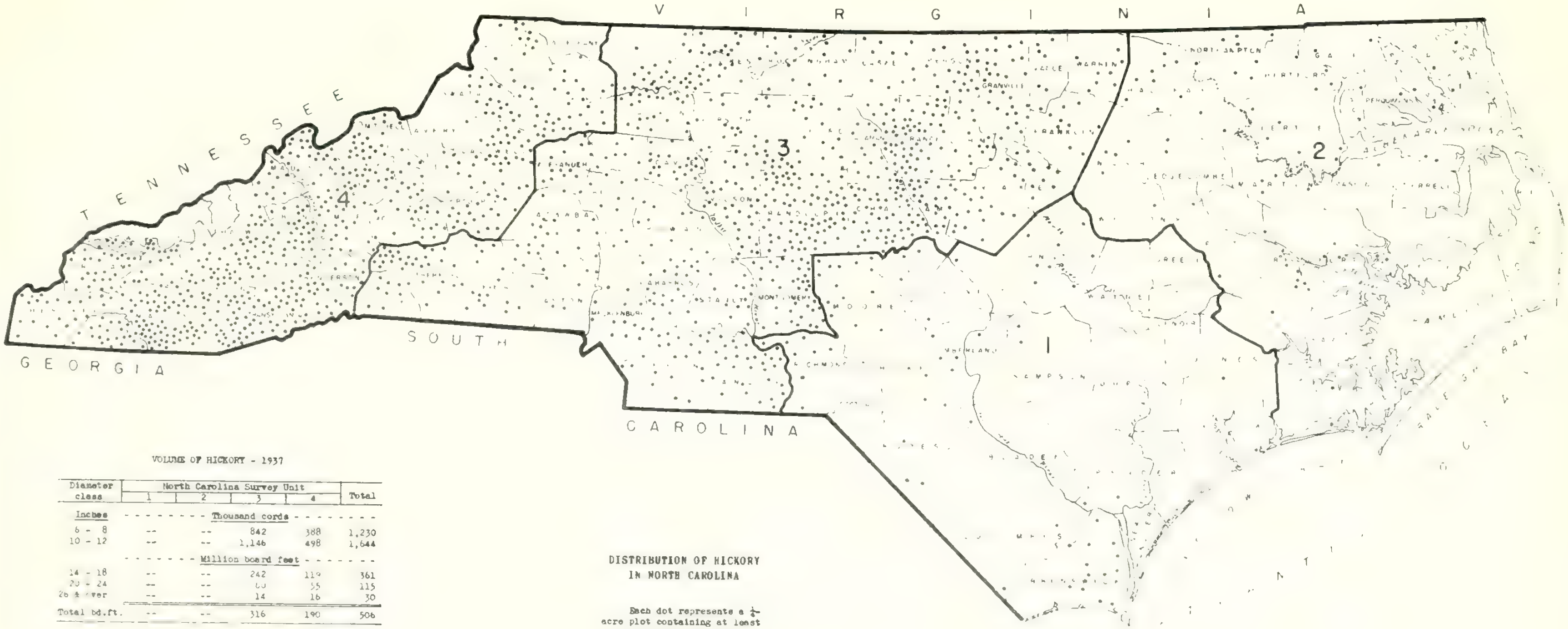
Diameter class	North Carolina Survey Unit				Total
	1	2	3	4*	
Inches	- - - - - - - - - - Thousand cords - - - - - - - - - -				
6 - 8	211	182	--	137	530
10 - 12	222	184	--	131	537
	- - - - - - Million board feet - - - - - - - -				
14 - 19	82	79	--	26	187
20 - 24	13	25	--	11	49
26 & over	10	6	--	2	18
Total bd.ft.	105	110	--	39	254

*Includes small quantity of cherry and walnut.

DISTRIBUTION OF ASH
IN NORTH CAROLINA

Each dot represents a ¼-acre plot containing at least one sound ash tree 12 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



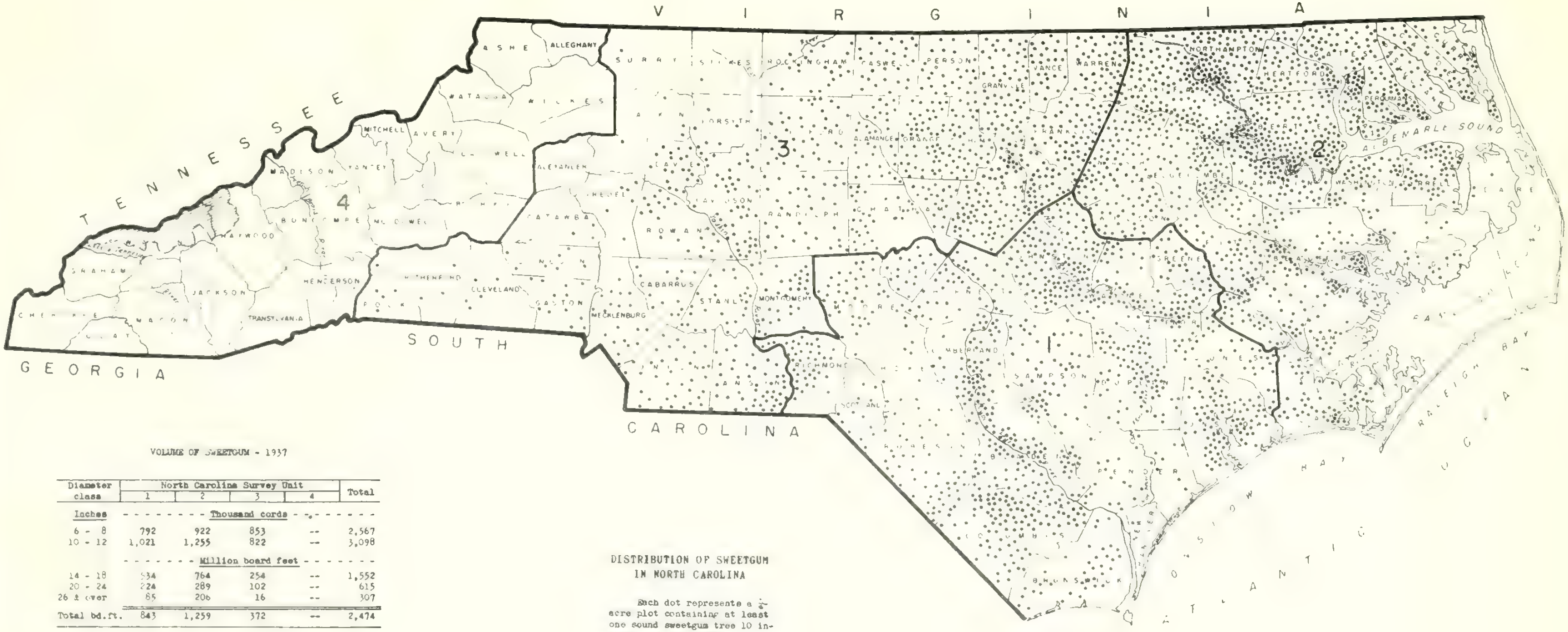
DISTRIBUTION OF HICKORY
IN NORTH CAROLINA

Each dot represents a ½-acre plot containing at least one sound hickory tree 12 inches d.b.h. or larger.

VOLUME OF HICKORY - 1937

Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches			Thousand cords		
6 - 8	--	--	842	388	1,230
10 - 12	--	--	1,146	498	1,644
			Million board feet		
14 - 18	--	--	242	119	361
20 - 24	--	--	60	55	115
26 & over	--	--	14	16	30
Total bd.ft.	--	--	316	190	506

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



VOLUME OF SWEETGUM - 1937

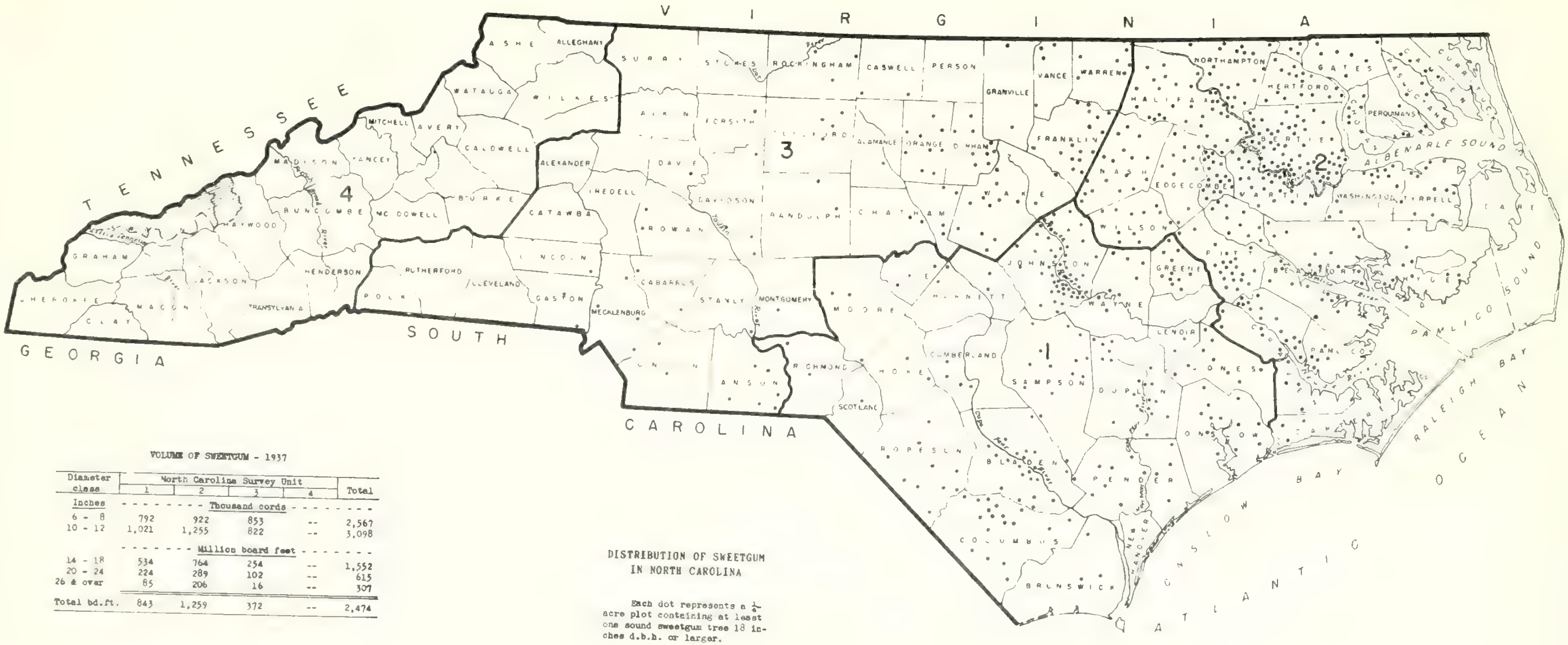
Diameter class	North Carolina Survey Unit 1	2	3	4	Total
Inches			Thousand cords		
6 - 8	792	922	853	--	2,567
10 - 12	1,021	1,255	822	--	3,098
			Million board feet		
14 - 18	534	764	254	--	1,552
20 - 24	224	289	102	--	615
26 & over	85	206	16	--	307
Total bd.ft.	843	1,259	372	--	2,474

DISTRIBUTION OF SWEETGUM
IN NORTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot containing at least one sound sweetgum tree 10 inches d.b.h. or larger.

NPB 12 2 40

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



VOLUME OF SWEETGUM - 1937

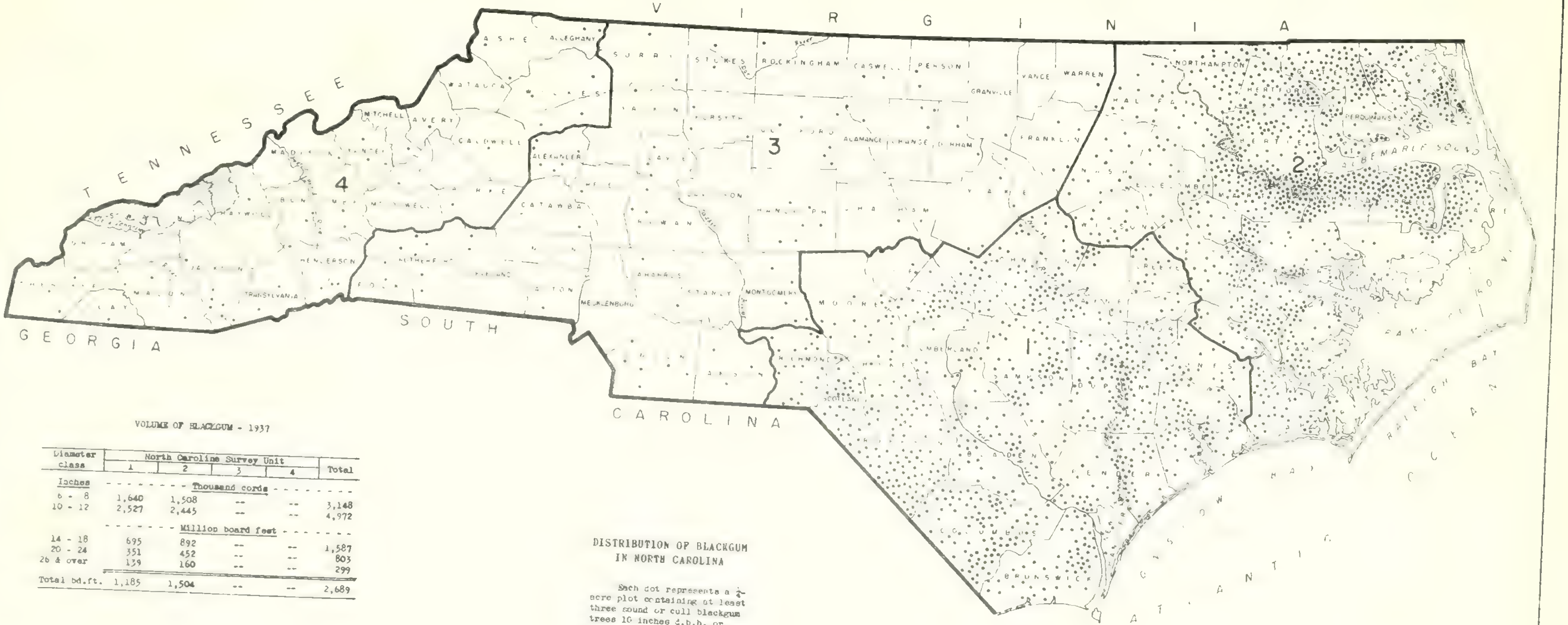
Diameter class	North Carolina Survey Unit 1	2	3	4	Total
Inches	- - - - - - - - -	Thousand cords	- - - -	- - - -	- - - -
6 - 8	792	922	853	--	2,567
10 - 12	1,021	1,255	822	--	3,098
	- - - - - - - -	Million board feet	- - - -	- - - -	- - - -
14 - 18	534	764	254	--	1,552
20 - 24	224	289	102	--	615
26 & over	85	206	16	--	307
Total bd.ft.	843	1,259	372	--	2,474

DISTRIBUTION OF SWEETGUM
IN NORTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot containing at least one sound sweetgum tree 18 inches d.b.h. or larger.

MPB 12-2-40

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



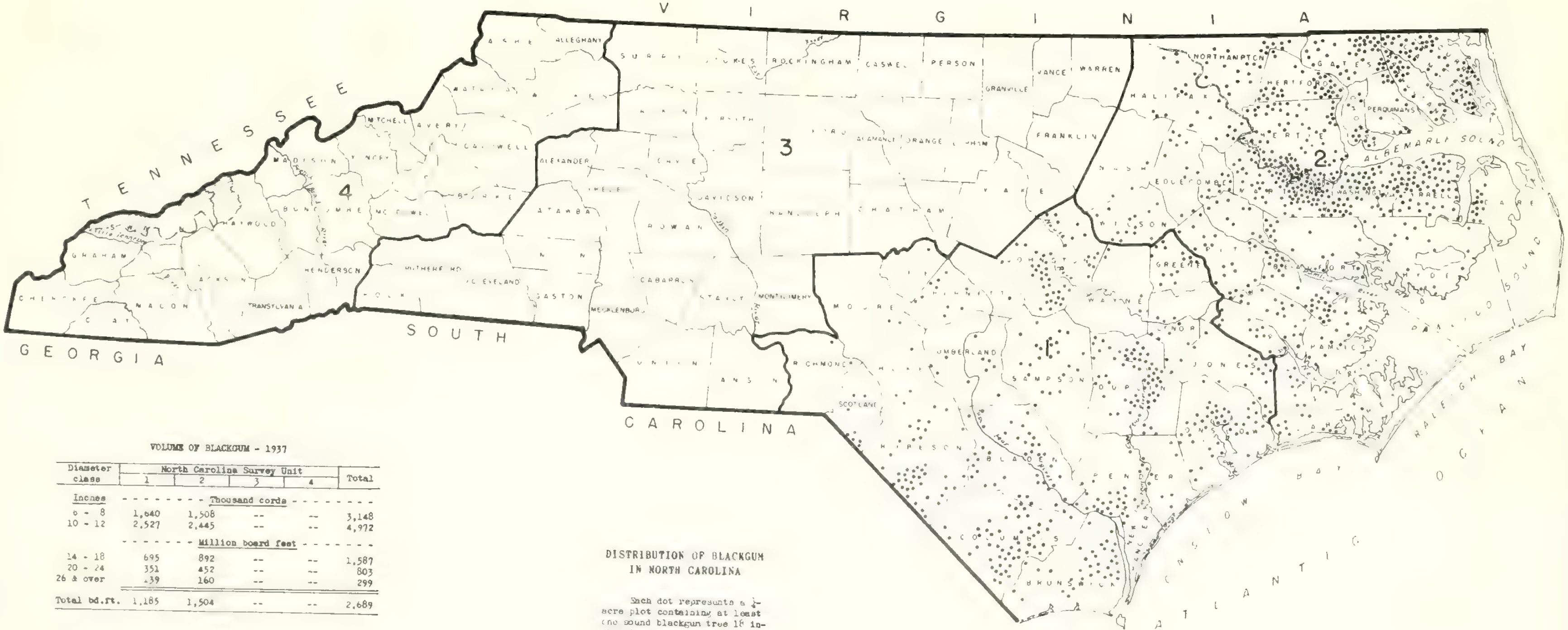
VOLUME OF BLACKGUM - 1937

Diameter class	North Caroline Survey Unit				Total
	1	2	3	4	
Inches	- - - - - - - - - - Thousand cords - - - - - - - - - -				
6 - 8	1,640	1,508	--	--	3,148
10 - 12	2,527	2,445	--	--	4,972
	- - - - - - - - - Million board feet - - - - - - - - -				
14 - 18	695	892	--	--	1,587
20 - 24	351	452	--	--	803
26 & over	139	160	--	--	299
Total bd.ft.	1,185	1,504	--	--	2,689

DISTRIBUTION OF BLACKGUM
IN NORTH CAROLINA

Each dot represents a ¼-acre plot containing at least three sound or cull blackgum trees 10 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



DISTRIBUTION OF BLACKGUM
IN NORTH CAROLINA

Each dot represents a ¼-acre plot containing at least one sound blackgum tree 18 inches d.b.h. or larger.

VOLUME OF BLACKGUM - 1937

Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches	- - - - - - - - -	Thousand cords	- - - - - - - - -		
6 - 8	1,640	1,508	--	--	3,148
10 - 12	2,527	2,445	--	--	4,972
	- - - - - - - -	Million board feet	- - - - - - - -		
14 - 18	695	892	--	--	1,587
20 - 24	351	452	--	--	803
26 & over	139	160	--	--	299
Total bd.ft.	1,185	1,504	--	--	2,689

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION

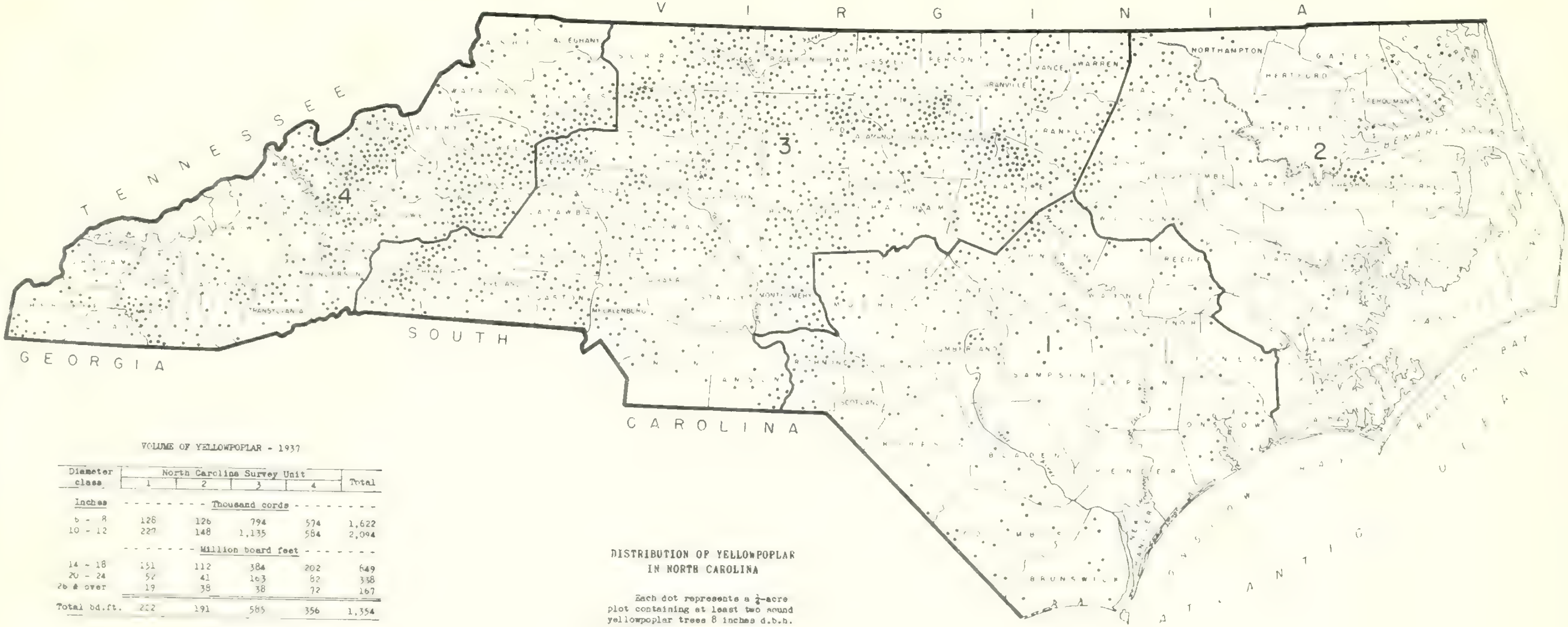
U. S. DEPARTMENT OF AGRICULTURE—FOREST SERVICE
APPALACHIAN FOREST EXPERIMENT STATION
R. E. McARDLE DIRECTOR

MAJOR FOREST TYPES
STATE OF NORTH CAROLINA

1940

Prepared by Forest Survey Staff
E. V. Roberts, Regional Survey Director

Type symbols show location of the major types [illegible]. No attempt has been made [illegible] types or agricultural [illegible]



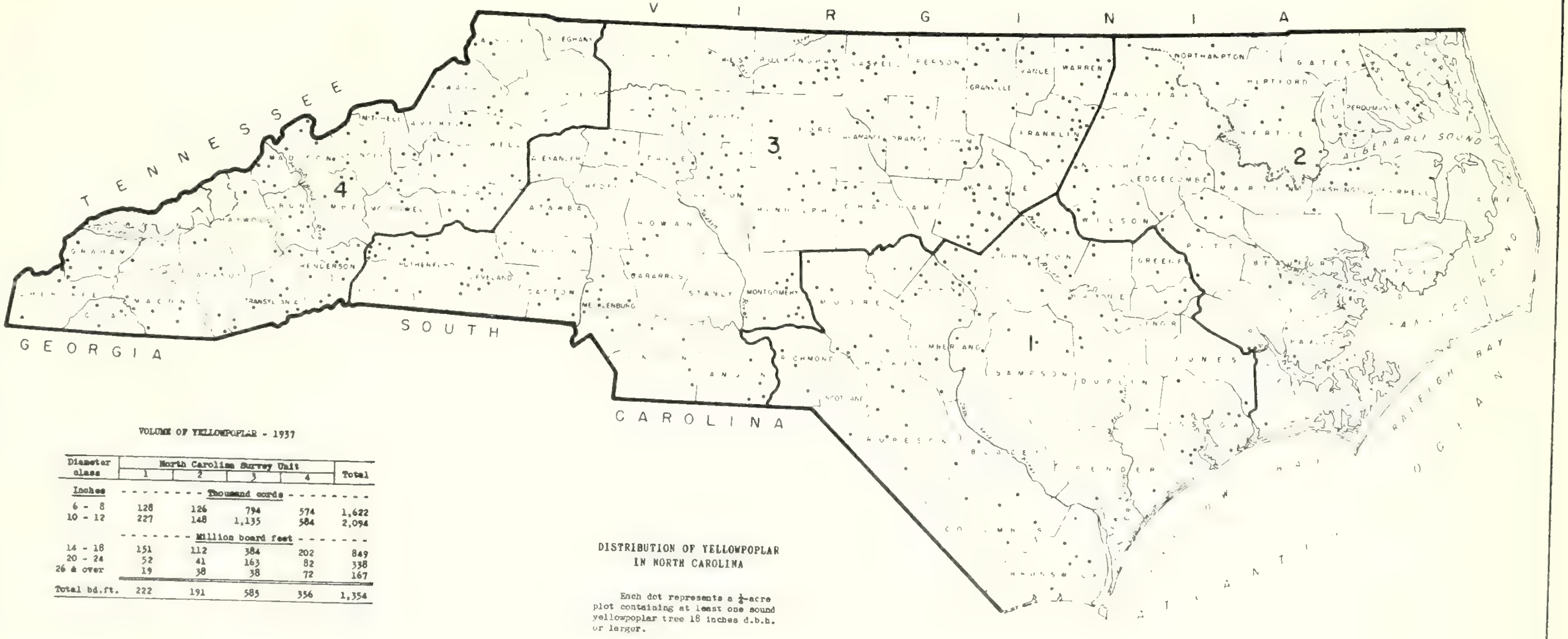
VOLUME OF YELLOWPOPLAR - 1937

Diameter class	North Carolina Survey Unit 1	2	3	4	Total
Inches	- - - - - - - -	- - - Thousand cords	- - -	- - -	- - -
6 - 8	126	126	794	574	1,622
10 - 12	227	148	1,135	584	2,094
	- - - - - - - -	- - Million board feet	- - -	- - -	- - -
14 - 18	151	112	384	202	849
20 - 24	52	41	163	82	338
26 & over	19	38	38	72	167
Total bd.ft.	222	191	585	356	1,354

DISTRIBUTION OF YELLOWPOPLAR
IN NORTH CAROLINA

Each dot represents a ½-acre plot containing at least two sound yellowpoplar trees 8 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



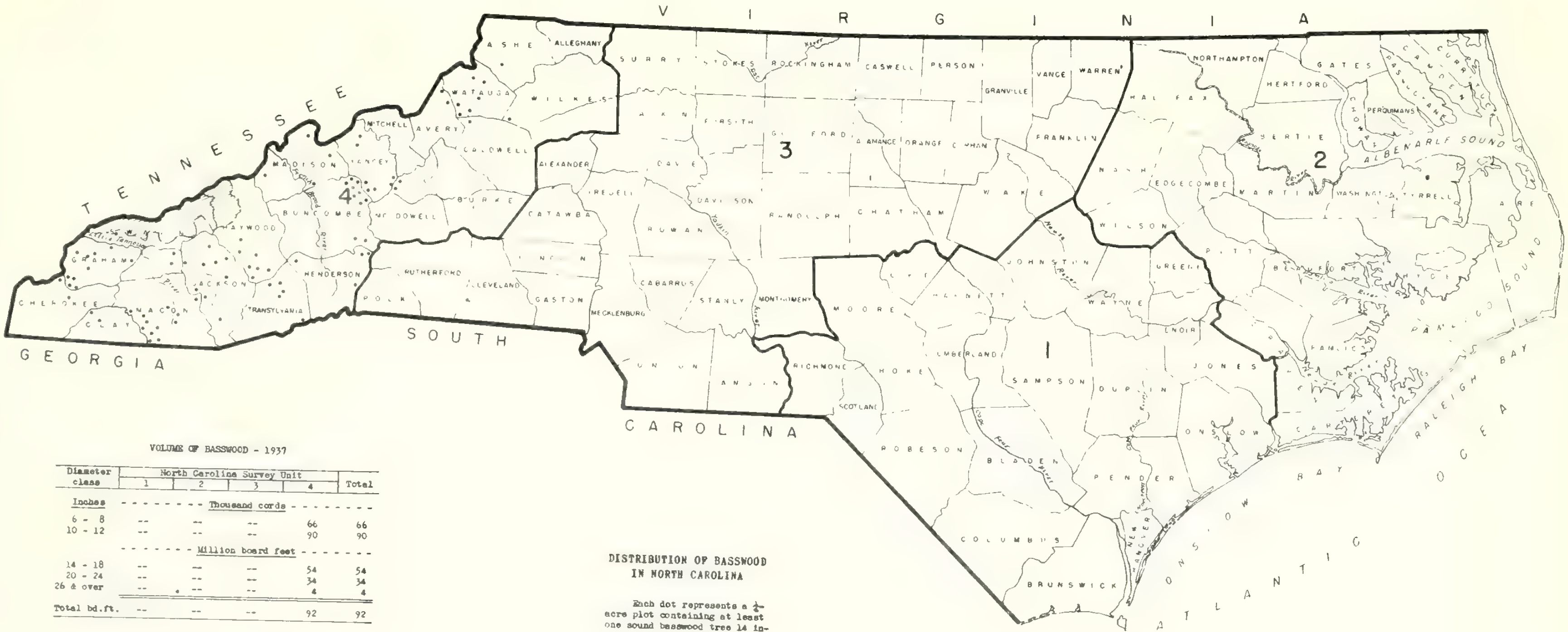
VOLUME OF YELLOWPOPLAR - 1937

Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches			Thousand cords		
6 - 8	128	126	794	574	1,622
10 - 12	227	148	1,135	584	2,094
			Million board feet		
14 - 18	151	112	384	202	849
20 - 24	52	41	163	82	338
26 & over	19	38	38	72	167
Total bd.ft.	222	191	585	356	1,354

DISTRIBUTION OF YELLOWPOPLAR
IN NORTH CAROLINA

Each dot represents a ¼-acre plot containing at least one sound yellowpoplar tree 18 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



VOLUME OF BASSWOOD - 1937

Diameter class	North Carolina Survey Unit				Total
	1	2	3	4	
Inches	- - - - - - - -	Thousand cords	- - - - - - - -		
6 - 8	--	--	--	66	66
10 - 12	--	--	--	90	90
	- - - - - - - -	Million board feet	- - - - - - - -		
14 - 18	--	--	--	54	54
20 - 24	--	--	--	34	34
26 & over	--	--	--	4	4
Total bd.ft.	--	--	--	92	92

DISTRIBUTION OF BASSWOOD
IN NORTH CAROLINA

Each dot represents a ¼-acre plot containing at least one sound basswood tree 14 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION

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FOREST SURVEY RELEASE NO. 9 MAY 15, 1941

THE DISTRIBUTION OF COMMERCIAL FOREST TREES IN SOUTH CAROLINA

by

E. V. Roberts, Regional Survey Director
and
J. W. Cruikshank, Associate Forest Economist

A FOREST SURVEY PROGRESS REPORT

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

Appalachian Forest Experiment Station
R. E. McArdle, Director
Asheville, N. C.

PREFACE

Through the McSweeny-McNary Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act, and each of the 12 Regional Forest Experiment Stations is responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station, Asheville, North Carolina.

The work of the Survey is divided into 5 major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of the timber on these lands.

2. Growth. Determination of the current rate of timber growth.

3. Drain. Determination of the amount of industrial and domestic wood use, and the total loss resulting from fire, insects, disease, suppression, and other causes.

4. Requirements. Determination of the current and probable future requirements for forest products by all classes of consumers.

5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis for public and private policies and plans of forest land use and management.

This progress report presents information on one part of the inventory phase of the Survey and deals specifically with the geographic distribution of the more important commercial forest trees in South Carolina.

The report is made possible through the assistance received from the personnel of the Work Projects Administration. Particular credit is due Mr. W. H. Winston and Mr. Harry Watkins of the Work Projects staff. The preparation of the maps from the basic field data were official projects 765-32-3-3 and 165-2-32-94.

Assisting Survey Staff

G. E. Morrill) Preparation of
T. C. Evans) Tables of Volume

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THE DISTRIBUTION OF COMMERCIAL FOREST TREES IN SOUTH CAROLINA

PURPOSE OF REPORT

The geographic distribution of the species of forest trees and their sizes is of considerable economic importance to the wood-using industries. The ordinary forest type maps are valuable for many purposes but for industrial use maps are needed which show where certain species and tree sizes are most abundant. Established plants must know the location of areas with suitable timber supplies and prospective wood-using industries need the same information in order to select desirable locations.

The maps included in this report are designed to provide more definite information regarding the location of forest tree species in South Carolina. They show where selected species of commercial importance occur and, what is more important from an industrial standpoint, the areas of dense concentration. Forest industries can thus avoid the expense of wide reconnaissance and can concentrate their wood procurement activities in the most favorable localities.

METHOD OF CONSTRUCTING MAPS

The sample plots established in 1934 and 1936 by the Forest Survey in the comprehensive inventory of the forest resources of South Carolina have been used in the construction of these maps. The plots were located at intervals of one-eighth of a mile on parallel compass lines 10 miles apart extending across each of the survey units into which the state was divided (fig. 1). The data recorded on each forest plot included a brief over-all description of the forest stand and a tally of the species, number, and size of all forest trees one inch and larger in diameter at breast height.

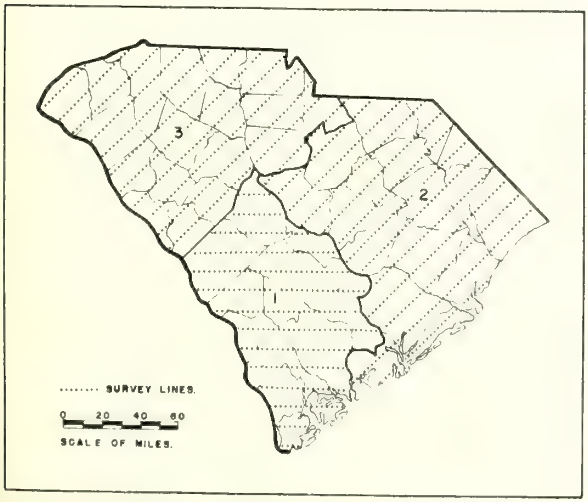

FIGURE 1.– APPROXIMATE LOCATION OF SURVEY LINES IN SOUTH CAROLINA.

This procedure gave an accurate picture of the timber stand on each forest plot, but because of the necessity for using a sampling method rather than a 100-percent tally of all forest land, each plot represents about 800 acres of forest. Obviously many local concentrations of timber could not be sampled and the maps are therefore not reliable for locating timber on small ownerships. Nearly 24,000 uniformly distributed plots in South Carolina do provide, however, a dependable measure of the commercial concentration of certain species and sizes within counties.

On each map the total volume of sound trees is shown by diameter-class for each unit and for the state. The volume of the under-sawlog-size trees is given in cords and the net volume of saw-timber material is given in board feet measured by the International $\frac{1}{4}$-inch rule, a close approximation of green lumber tally. In a few units the volume of certain species is insignificant and is not shown separately.

The accompanying maps are of two distinct kinds; those based upon forest types and those based upon species and diameter-class. They are described as follows.

Maps Based on Forest Types

The maps showing the distribution of loblolly, shortleaf, longleaf, slash, and Virginia pines are based upon forest types. That is, every dot represents a forest plot on which the designated pine type is predominant. On the map showing the distribution of loblolly pine in South Carolina, for example, each dot is a forest plot typed in the field as loblolly pine. Other pine species may have been present upon the plot but not in sufficient quantity to influence the type classification. This method delineates the area dominated by a particular pine species and is not intended to indicate the maximum range of any one species.

Maps Based on Species and Diameter Class

The maps showing the distribution of redcedar, cypress, red and white oaks, hickory, sweetgum, blackgum and tupelo, and yellowpoplar are based upon the occurrence of individual trees on the sample plot. For example, each dot on the map showing the distribution of cypress represents a plot on which there was at least one sound cypress tree 12.0 inches or larger in diameter at breast height. On many of these plots there were undoubtedly several large cypresses. As every species was not plotted uniformly in regard to the number of individual trees per plot or size-class represented, the basis is given in the legend of each map. The distribution of oaks, gums, and yellowpoplar 18.0 inches d.b.h. and larger has been presented to facilitate industrial use of these premium sizes.

THE FORESTS OF SOUTH CAROLINA[1]

Species

In South Carolina forests occupy about 11 million acres, 55 percent of all the land. Loblolly pine greatly exceeds the other species in abundance, particularly in the Coastal Plain. Shortleaf pine, second in volume rating, is concentrated in the Piedmont but occurs throughout the state. Longleaf pine is common in the Coastal Plain but comparatively rare elsewhere. Slash pine grows in the extreme southern portion and Virginia pine in the extreme northwestern portion of the state but the quantity of both these species is small.

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[1] A detailed description of South Carolina's forest resources and industries is presented in the Forest Survey Releases listed on page 3. Copies of these releases may be obtained by writing the Appalachian Forest Experiment Station, Asheville, North Carolina.

Sweetgum leads the hardwoods in board-foot volume and is especially abundant in the northern part of the Coastal Plain. Blackgum and tupelo also make up a high proportion of the stand in that area and to a smaller degree in the entire Coastal region. The red and white oaks are distributed throughout the state but attain their best development along the larger rivers near the coast. Many other hardwoods are common, notably yellowpoplar, ash, and several species of hickory.

Forest Types

The pine types occupy 73 percent of the forest land. There are about four million acres of loblolly pine-hardwoods, two million acres of shortleaf pine-hardwoods including Virginia pine, and 1.8 million acres of longleaf and slash pine.

Hardwood types occupy the remaining 2.9 million acres of the forest land. The bottom-land hardwoods, 2.2 million acres in extent, are located in extensive bottom lands of the Coastal Plain. They are an important component of the forest because they contain a high proportion of old-growth material. The upland hardwoods type, which occupies 700,000 acres in the Piedmont and Coastal Plain, is usually composed of oaks, hickories and yellowpoplars in mixture with other hardwoods of less common occurrence.

Forest Conditions

About 15 percent of the forest land is stocked with old-growth timber, 43 percent is stocked with sawlog-size second growth, 41 percent with under-sawlog-size second growth, and one percent is clearcut and not restocking. Almost one-half of the 1.6 million acres of old growth are bottom-land hardwoods. The 4.6 million acres of second-growth saw timber are distributed rather uniformly throughout the state and are about one-half loblolly pine-hardwoods. One-third of the 4.4 million acres of young second growth are also stocked with loblolly pine. Nearly all of the 124,000 acres of clear-cut land are located in the northern part of the Coastal Plain.

FOREST SURVEY RELEASES PERTAINING TO SOUTH CAROLINA

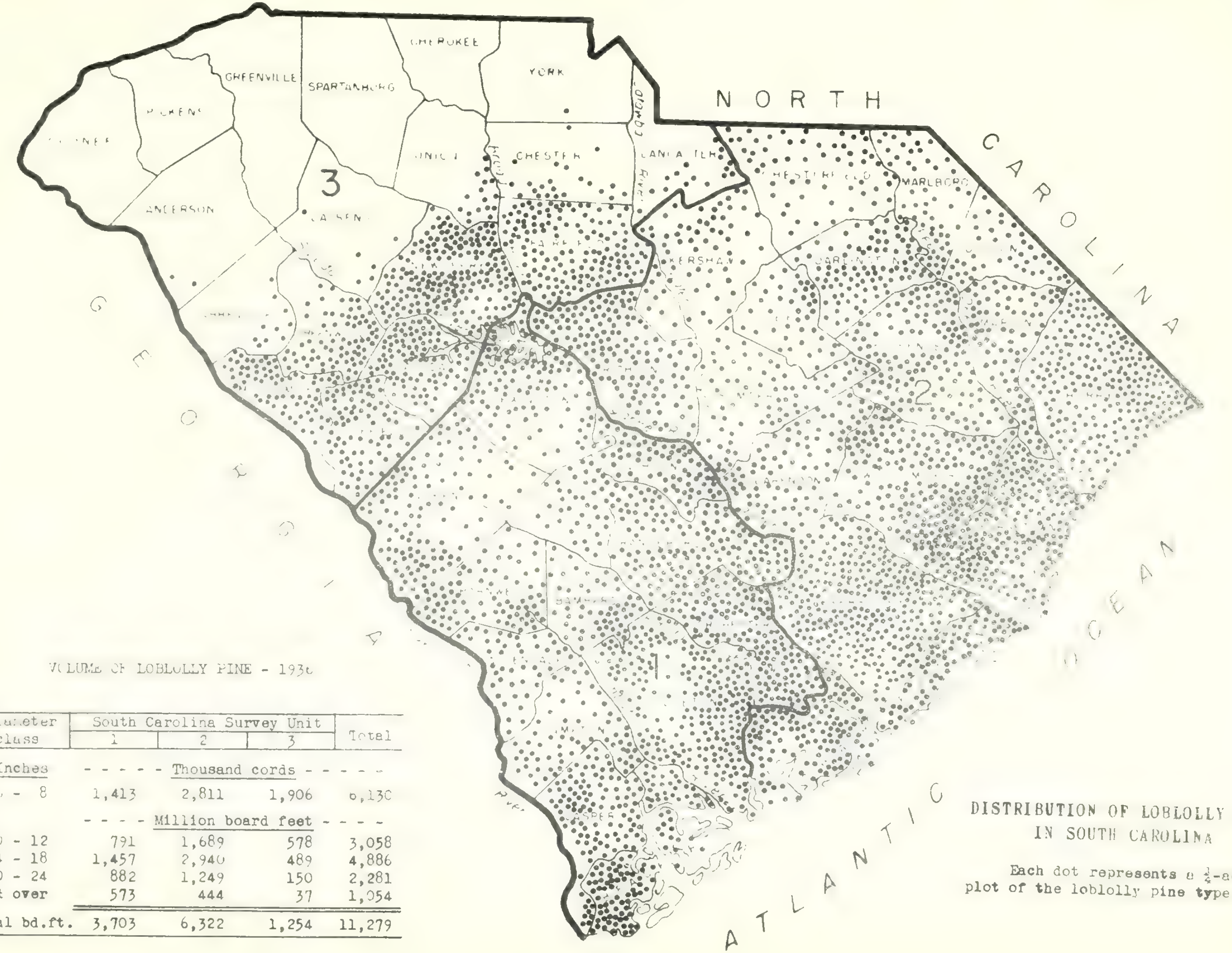
Forest Resources of the Northern Coastal Plain of South Carolina.
Forest Survey Release No. 1, July 15, 1939. (Survey Unit No. 2).

Forest Resources of the Piedmont Region of South Carolina.
Forest Survey Release No. 2, September 1, 1939. (Survey Unit No. 3).

Forest Resources of the Southern Coastal Plain of South Carolina.
Forest Survey Release No. 3, December 1, 1939. (Survey Unit No. 1).

DISTRIBUTION MAPS OF COMMERCIAL FOREST TREES

Map	Tree Species Included
Loblolly pine	- Loblolly pine
Shortleaf pine	- Shortleaf pine
Longleaf pine	- Longleaf pine
Slash pine	- Slash pine
Virginia pine	- Virginia pine
Redcedar	- Eastern redcedar
Cypress	- Baldcypress, pondcypress
Red oak	- Black, scarlet, water, willow, southern red, cherrybark, and northern red oak
White oak	- White oak, swamp chestnut oak
Hickory	- Bitternut, water, shagbark, mockernut, and pignut hickory
Sweetgum	- Sweetgum
Blackgum	- Blackgum, water tupelo
Yellowpoplar	- Yellowpoplar



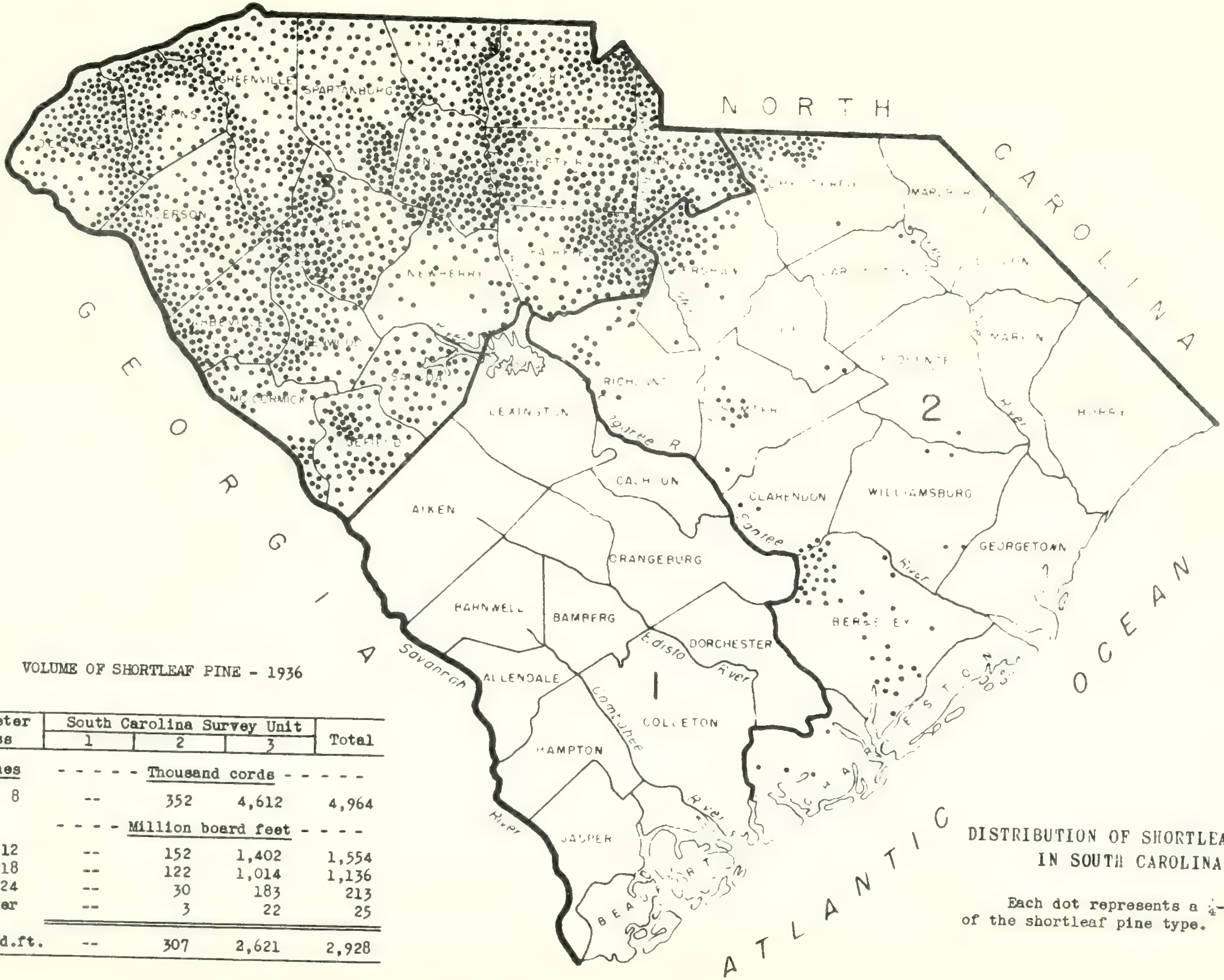
DISTRIBUTION OF LOBLOLLY PINE IN SOUTH CAROLINA

Each dot represents a ¼-acre plot of the loblolly pine type.

VOLUME OF LOBLOLLY PINE - 1936

Diameter class	South Carolina Survey Unit 1	2	3	Total
Inches	- - - - - Thousand cords - - - - -			
6 - 8	1,413	2,811	1,906	6,130
	- - - - Million board feet - - - -			
10 - 12	791	1,689	578	3,058
14 - 18	1,457	2,940	489	4,886
20 - 24	882	1,249	150	2,281
26 & over	573	444	37	1,054
Total bd.ft.	3,703	6,322	1,254	11,279

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



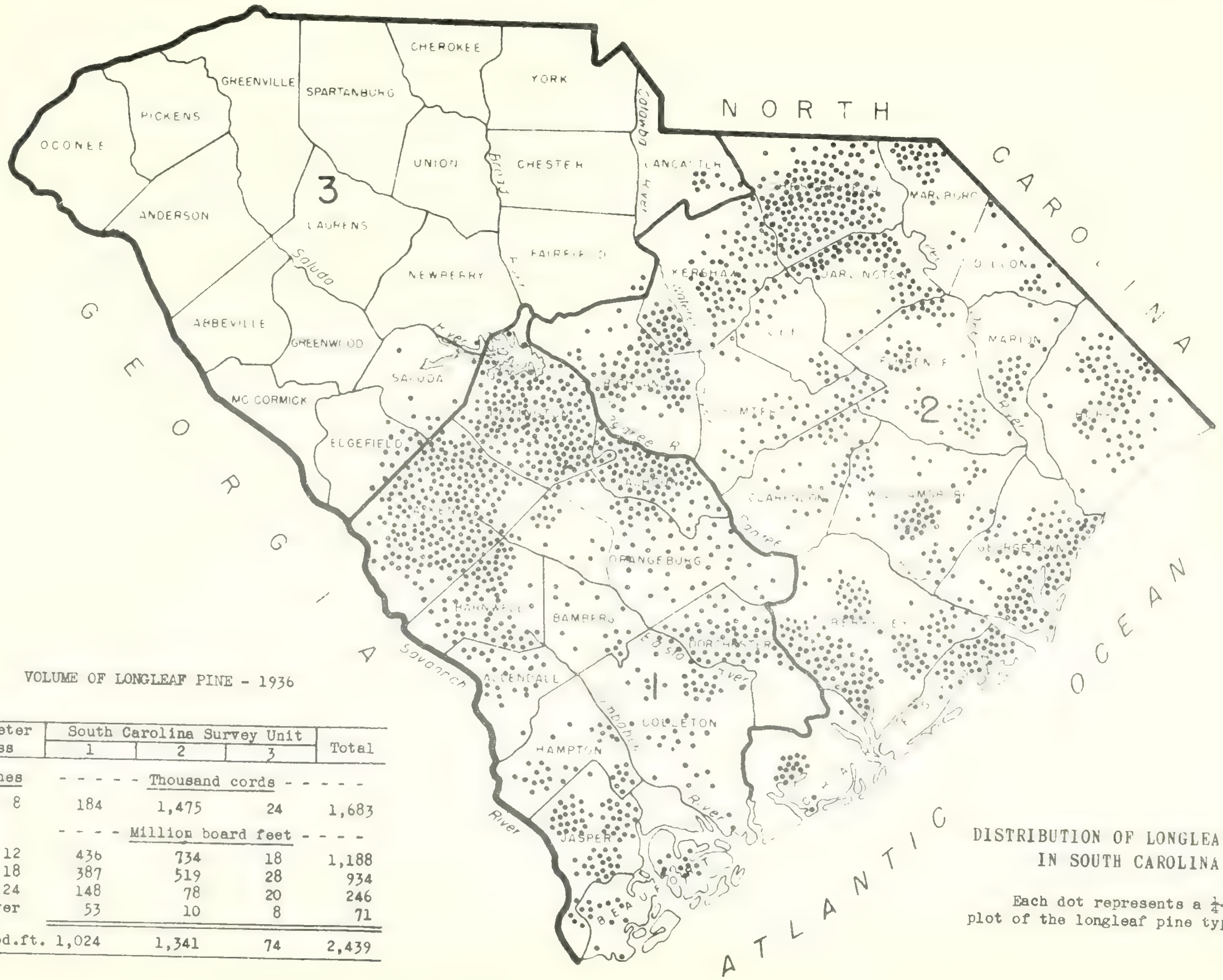
DISTRIBUTION OF SHORTLEAF PINE IN SOUTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot of the shortleaf pine type.

VOLUME OF SHORTLEAF PINE - 1936

Diameter class	South Carolina Survey Unit 1	2	3	Total
Inches	- - - - -	Thousand cords	- - - - -	
6 - 8	--	352	4,612	4,964
	- - - -	Million board feet	- - - -	
10 - 12	--	152	1,402	1,554
14 - 18	--	122	1,014	1,136
20 - 24	--	30	183	213
26 & over	--	3	22	25
Total bd.ft.	--	307	2,621	2,928

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



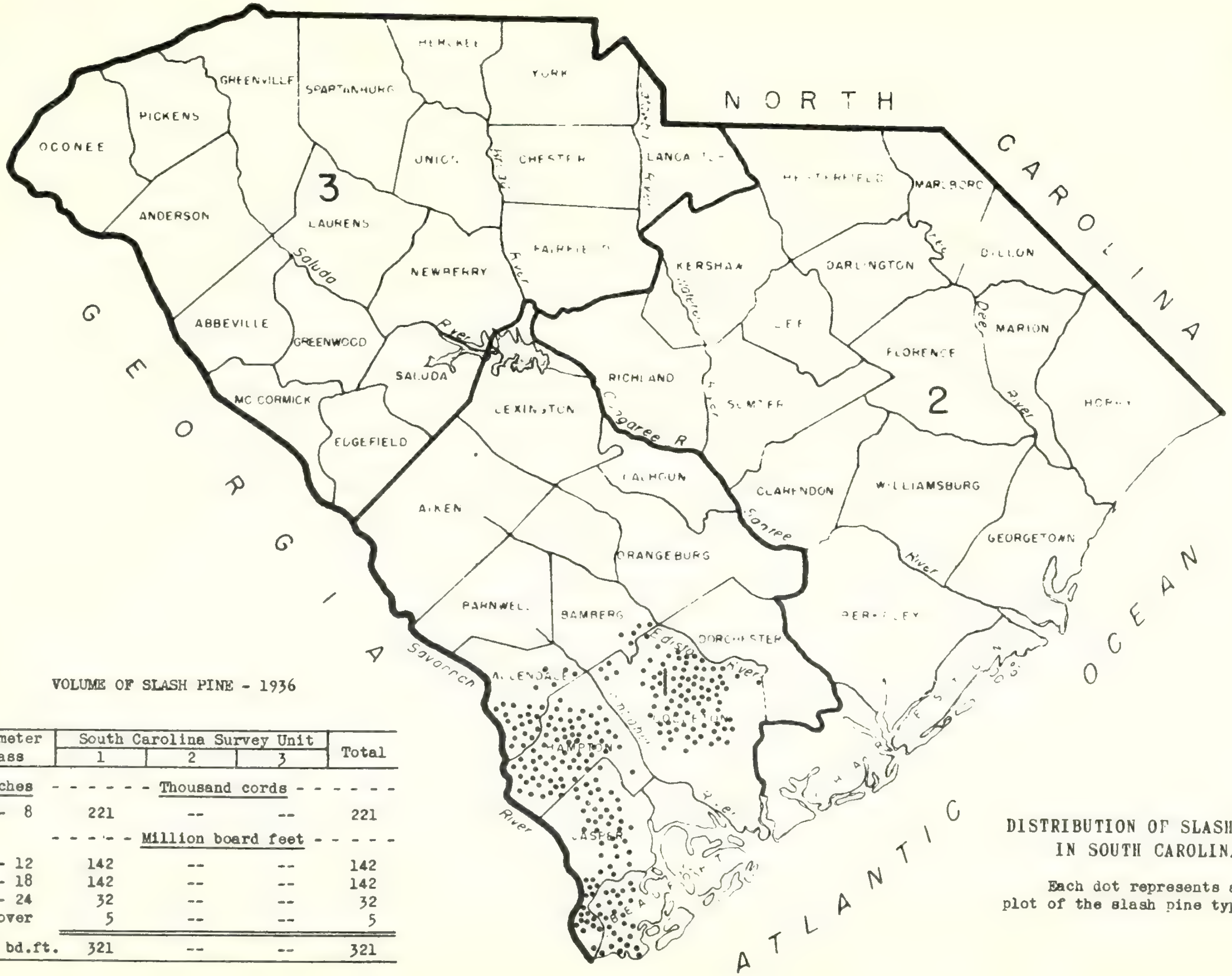
DISTRIBUTION OF LONGLEAF PINE IN SOUTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot of the longleaf pine type.

VOLUME OF LONGLEAF PINE - 1936

Diameter class	South Carolina Survey Unit 1	2	3	Total
Inches	- - - - - Thousand cords - - - - -			
6 - 8	184	1,475	24	1,683
	- - - - Million board feet - - - -			
10 - 12	436	734	18	1,188
14 - 18	387	519	28	934
20 - 24	148	78	20	246
26 & over	53	10	8	71
Total bd.ft.	1,024	1,341	74	2,439

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



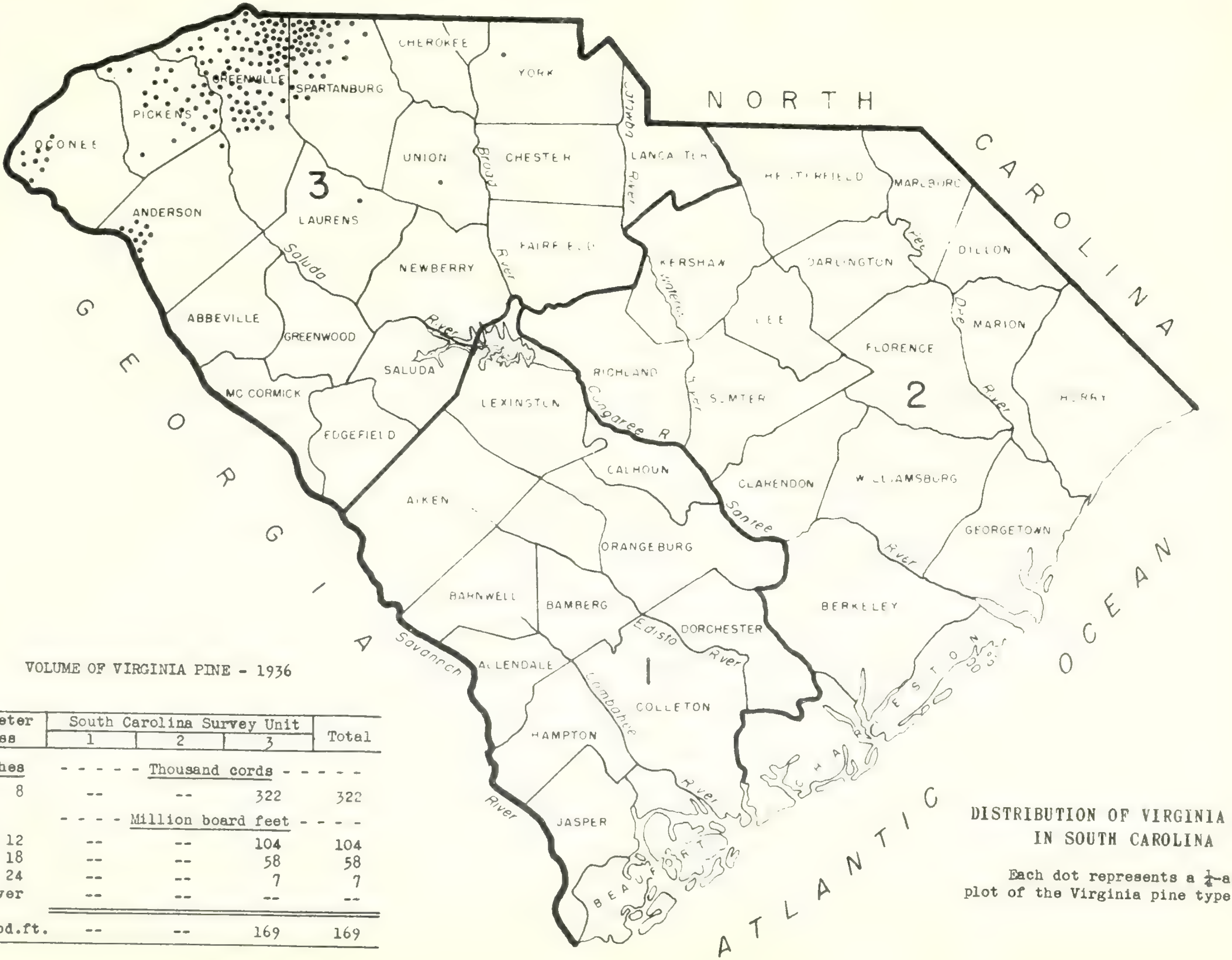
DISTRIBUTION OF SLASH PINE IN SOUTH CAROLINA

Each dot represents a ¼-acre plot of the slash pine type.

VOLUME OF SLASH PINE - 1936

Diameter class	South Carolina Survey Unit 1	South Carolina Survey Unit 2	South Carolina Survey Unit 3	Total
Inches	- - - - - -	Thousand cords	- - - - - -	
6 - 8	221	--	--	221
	- - - - -	Million board feet	- - - - -	
10 - 12	142	--	--	142
14 - 18	142	--	--	142
20 - 24	32	--	--	32
26 & over	5	--	--	5
Total bd.ft.	321	--	--	321

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



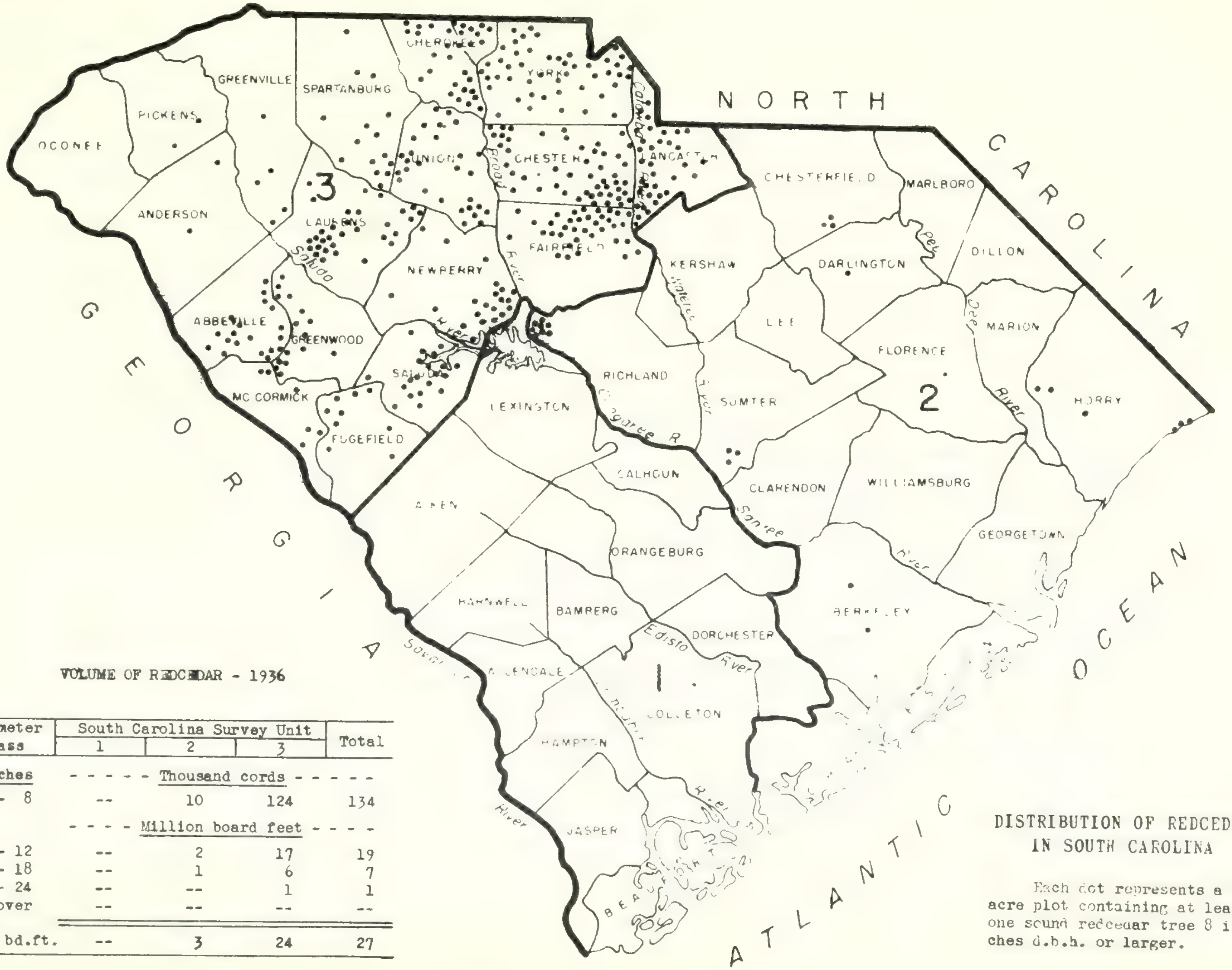
VOLUME OF VIRGINIA PINE - 1936

Diameter class	South Carolina Survey Unit 1	2	3	Total
Inches	- - - - -	Thousand cords	- - - - -	
6 - 8	--	--	322	322
	- - - -	Million board feet	- - - -	
10 - 12	--	--	104	104
14 - 18	--	--	58	58
20 - 24	--	--	7	7
26 & over	--	--	--	--
Total bd.ft.	--	--	169	169

DISTRIBUTION OF VIRGINIA PINE
IN SOUTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot of the Virginia pine type.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



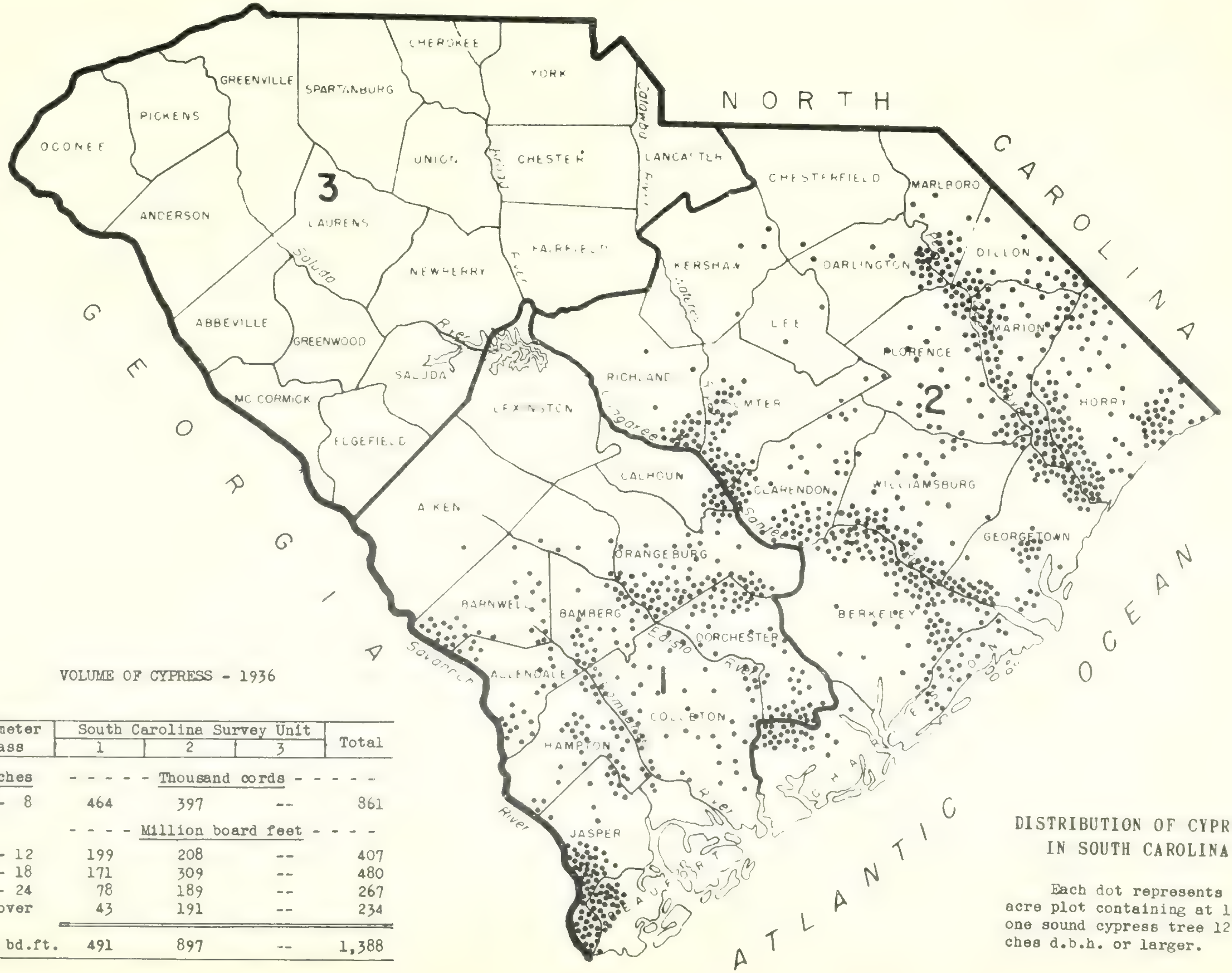
DISTRIBUTION OF REDCEDAR
IN SOUTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot containing at least one sound redcedar tree 8 inches d.b.h. or larger.

VOLUME OF REDCEDAR - 1936

Diameter class	South Carolina Survey Unit			Total
	1	2	3	
Inches	- - - - -	Thousand cords	- - - - -	
6 - 8	--	10	124	134
	- - - -	Million board feet	- - - -	
10 - 12	--	2	17	19
14 - 18	--	1	6	7
20 - 24	--	--	1	1
26 & over	--	--	--	--
Total bd.ft.	--	3	24	27

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



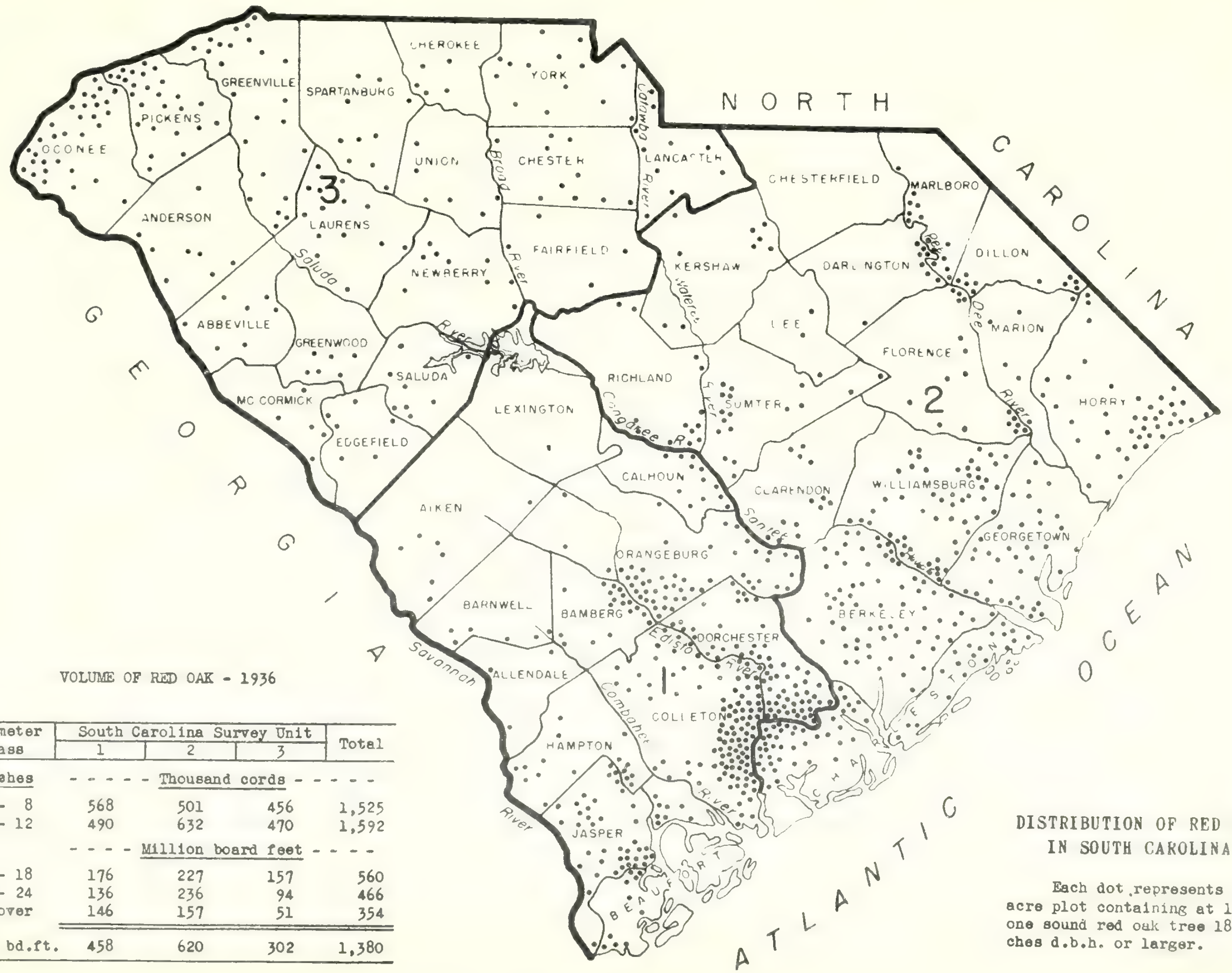
VOLUME OF CYPRESS - 1936

Diameter class	South Carolina Survey Unit 1	2	3	Total
Inches	- - - - - Thousand cords - - - - -			
6 - 8	464	397	--	861
	- - - - Million board feet - - - -			
10 - 12	199	208	--	407
14 - 18	171	309	--	480
20 - 24	78	189	--	267
26 & over	43	191	--	234
Total bd.ft.	491	897	--	1,388

DISTRIBUTION OF CYPRESS
IN SOUTH CAROLINA

Each dot represents a ¼-acre plot containing at least one sound cypress tree 12 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



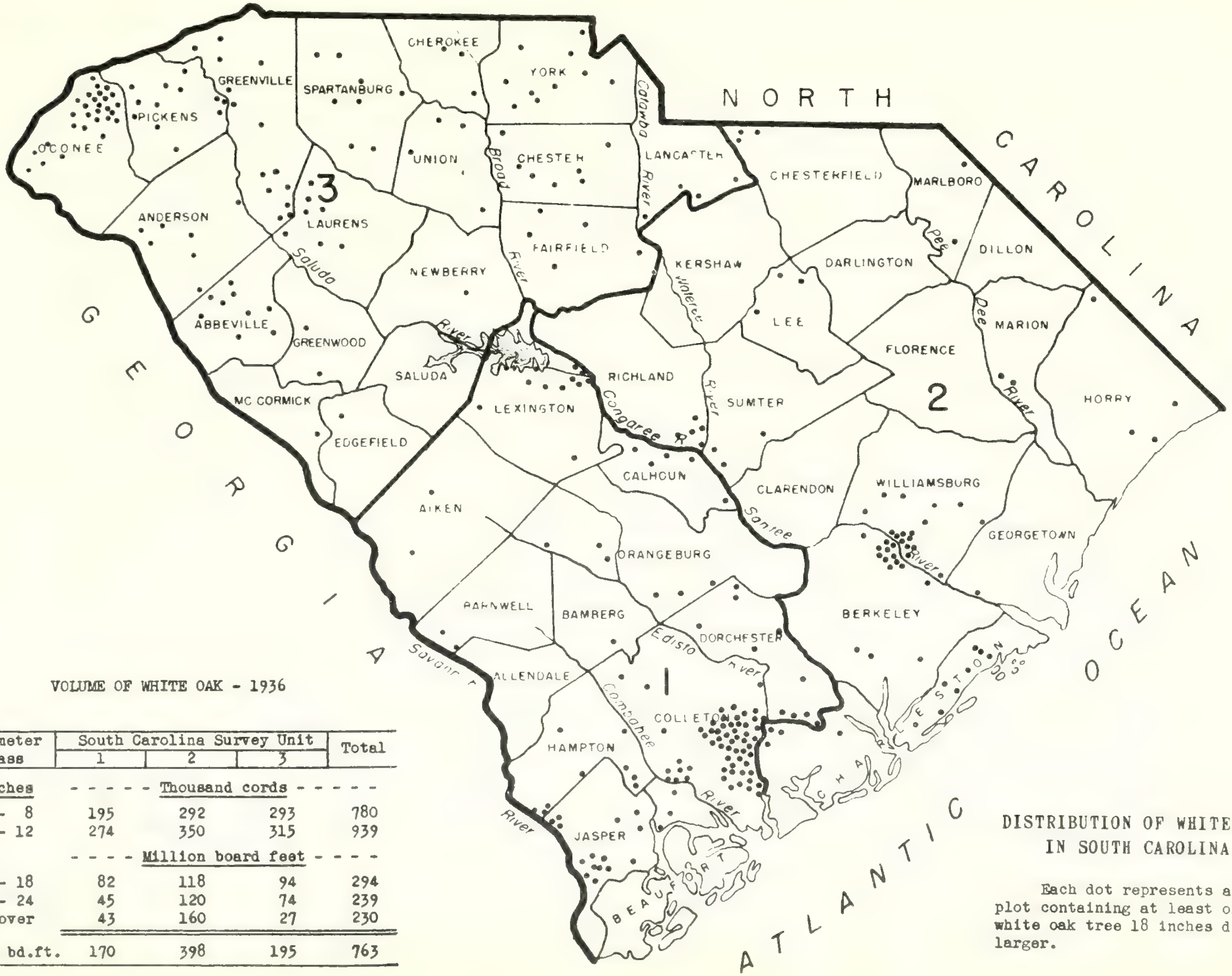
DISTRIBUTION OF RED OAK
IN SOUTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot containing at least one sound red oak tree 18 inches d.b.h. or larger.

VOLUME OF RED OAK - 1936

Diameter class	South Carolina Survey Unit 1	2	3	Total
Inches	- - - - -	Thousand cords	- - - - -	
6 - 8	568	501	456	1,525
10 - 12	490	632	470	1,592
	- - - -	Million board feet	- - - -	
14 - 18	176	227	157	560
20 - 24	136	236	94	466
26 & over	146	157	51	354
Total bd.ft.	458	620	302	1,380

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



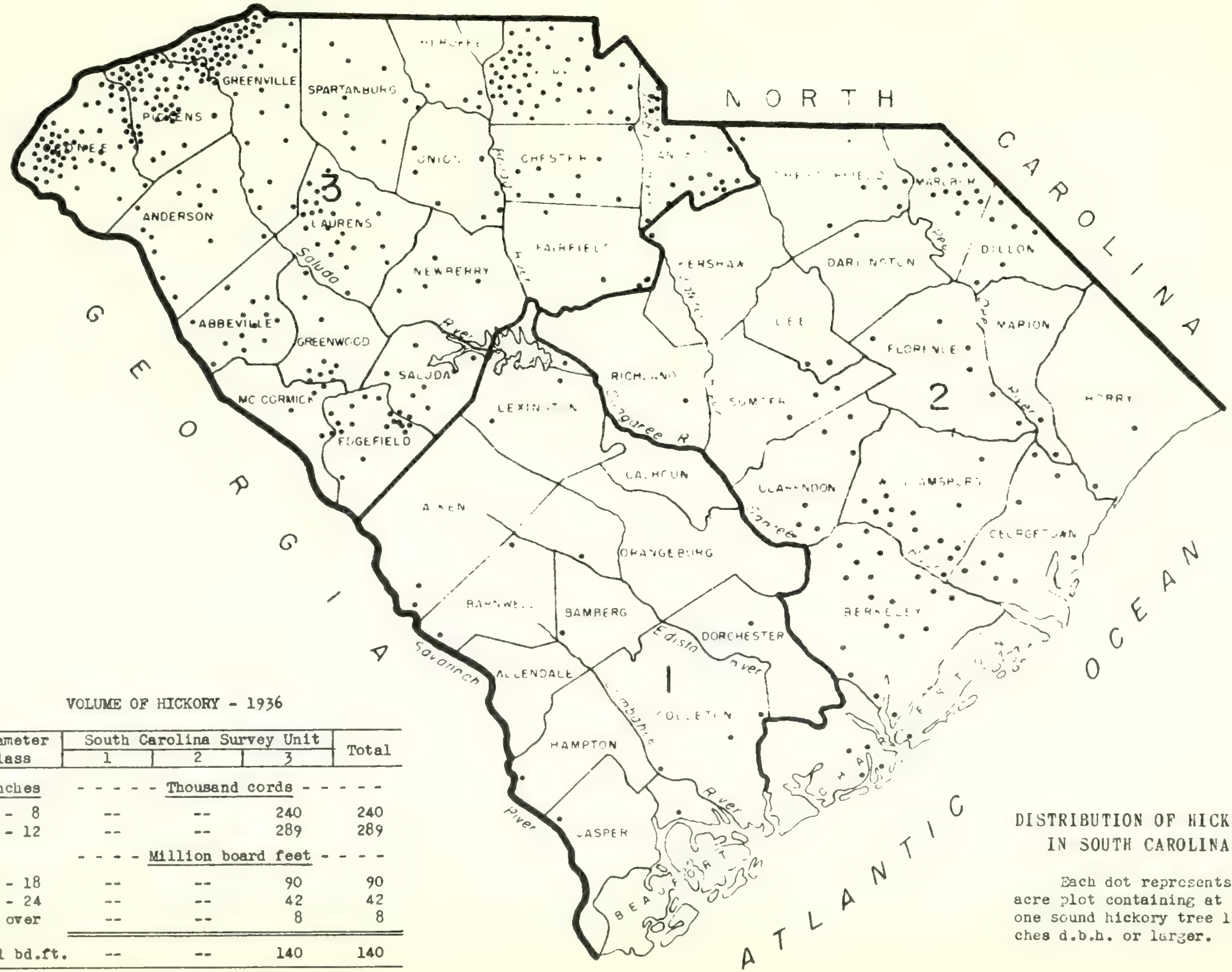
DISTRIBUTION OF WHITE OAK IN SOUTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot containing at least one sound white oak tree 18 inches d.b.h. or larger.

VOLUME OF WHITE OAK - 1936

Diameter class	South Carolina Survey Unit 1	South Carolina Survey Unit 2	South Carolina Survey Unit 3	Total
Inches	- - - - - Thousand cords - - - - -			
6 - 8	195	292	293	780
10 - 12	274	350	315	939
	- - - - Million board feet - - - -			
14 - 18	82	118	94	294
20 - 24	45	120	74	239
26 & over	43	160	27	230
Total bd.ft.	170	398	195	763

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



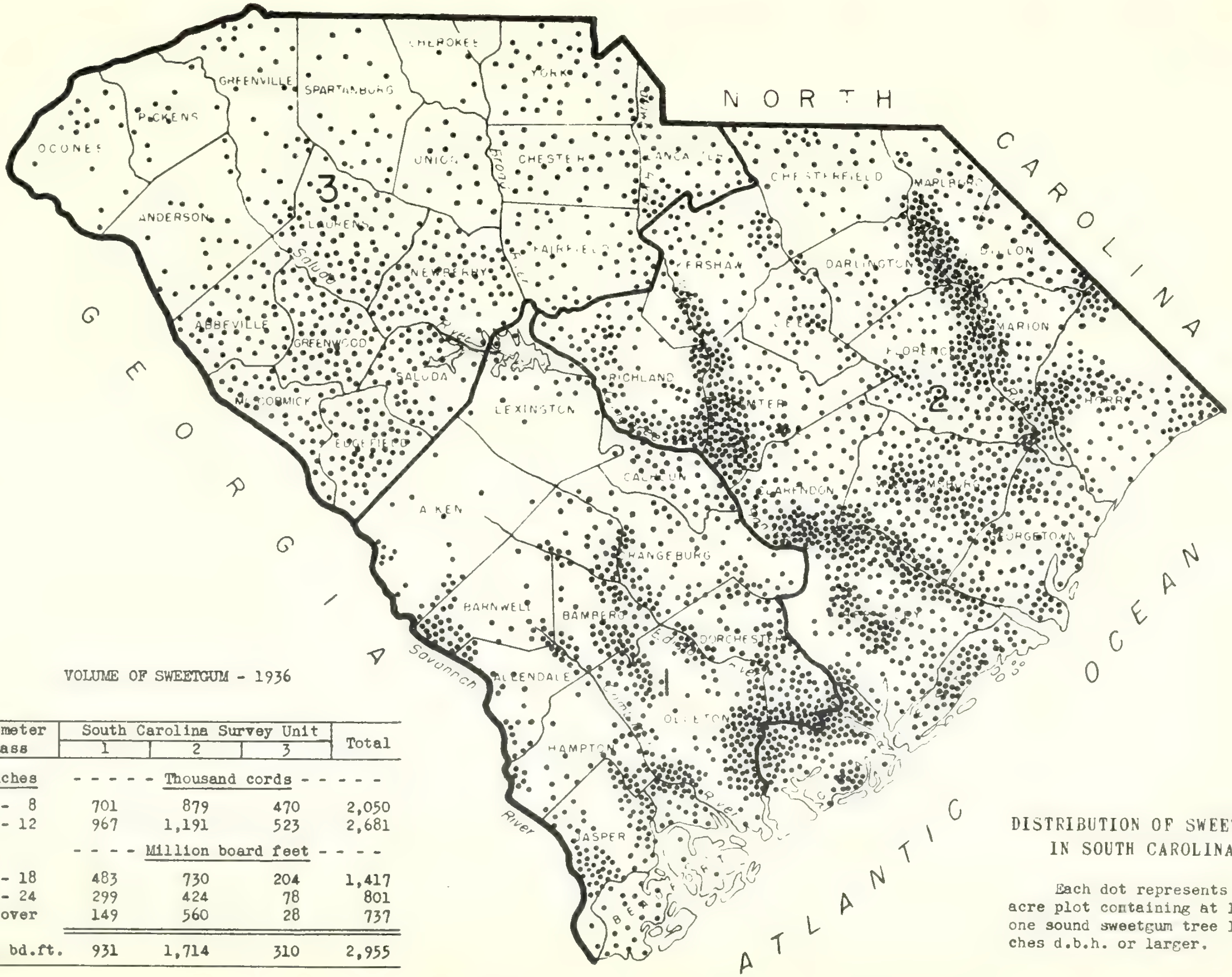
VOLUME OF HICKORY - 1936

Diameter class	South Carolina Survey Unit 1	South Carolina Survey Unit 2	South Carolina Survey Unit 3	Total
Inches		- - - - - Thousand cords - - - - -		
6 - 8	--	--	240	240
10 - 12	--	--	289	289
		- - - - Million board feet - - - -		
14 - 18	--	--	90	90
20 - 24	--	--	42	42
26 & over	--	--	8	8
Total bd.ft.	--	--	140	140

DISTRIBUTION OF HICKORY IN SOUTH CAROLINA

Each dot represents a ¼-acre plot containing at least one sound hickory tree 12 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



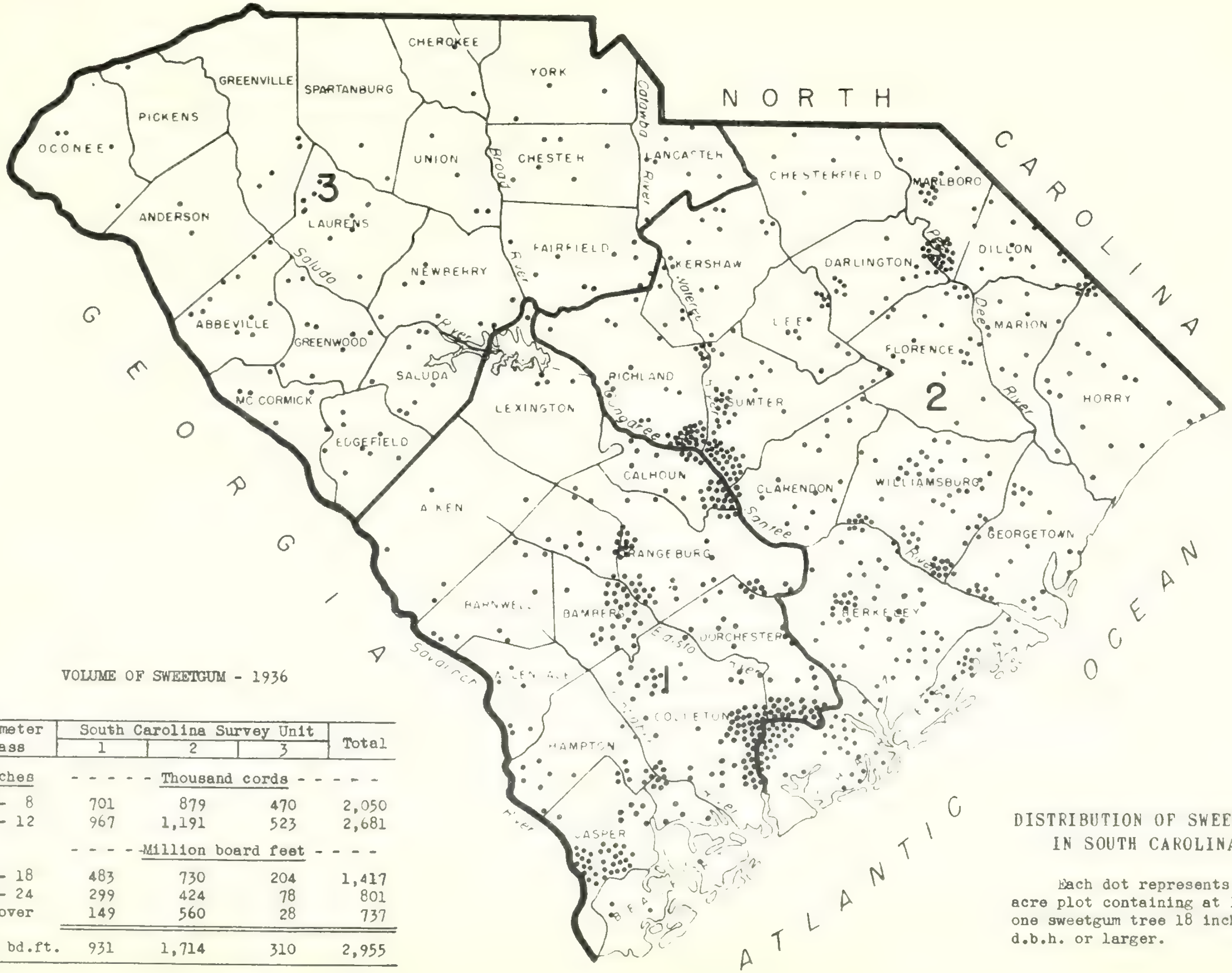
VOLUME OF SWEETGUM - 1936

Diameter class	South Carolina Survey Unit 1	South Carolina Survey Unit 2	South Carolina Survey Unit 3	Total
Inches	- - - - - Thousand cords - - - - -			
6 - 8	701	879	470	2,050
10 - 12	967	1,191	523	2,681
	- - - - Million board feet - - - -			
14 - 18	483	730	204	1,417
20 - 24	299	424	78	801
26 & over	149	560	28	737
Total bd.ft.	931	1,714	310	2,955

DISTRIBUTION OF SWEETGUM
IN SOUTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot containing at least one sound sweetgum tree 10 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



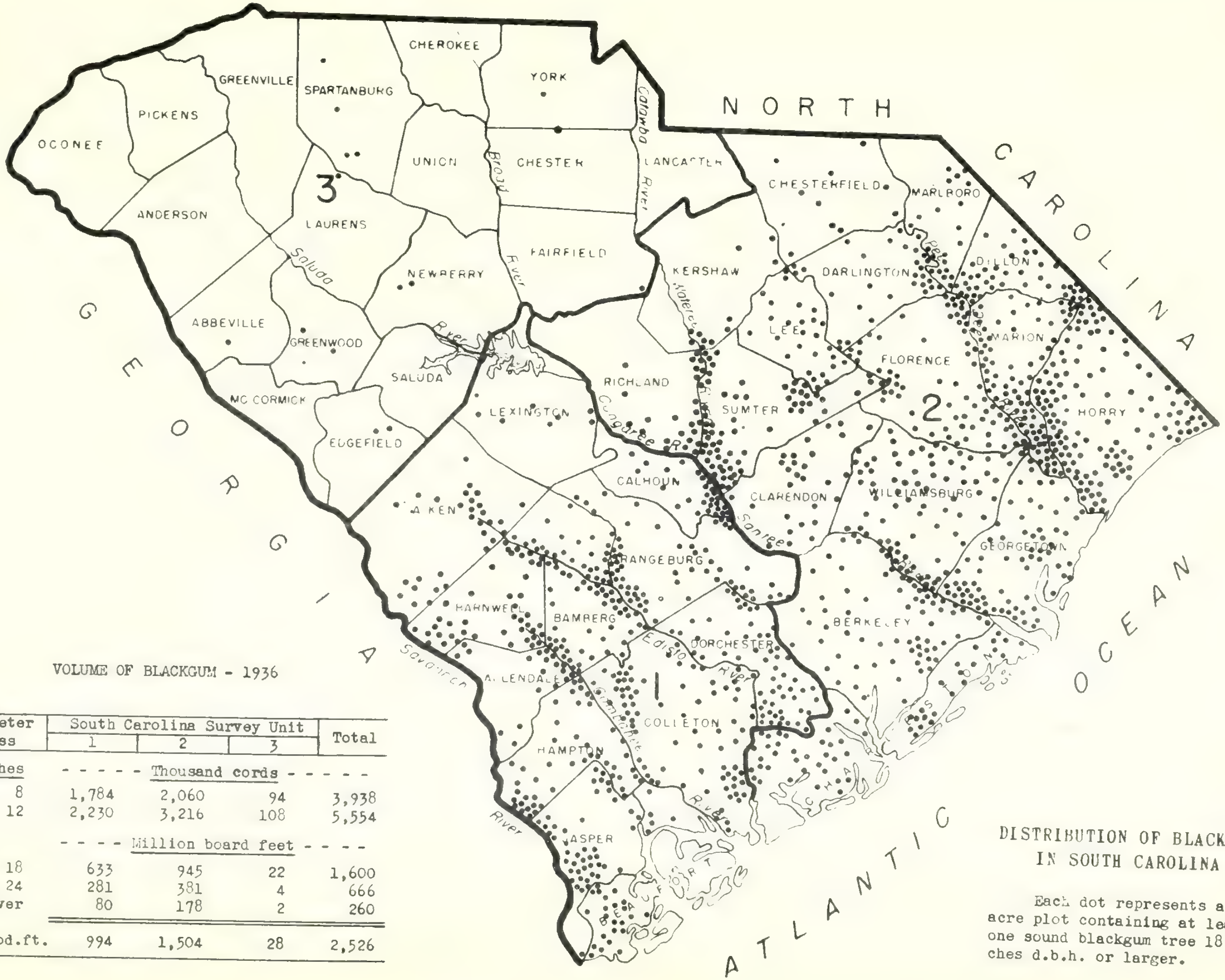
VOLUME OF SWEETGUM - 1936

Diameter class	South Carolina Survey Unit			Total
	1	2	3	
Inches	- - - - - Thousand cords - - - - -			
6 - 8	701	879	470	2,050
10 - 12	967	1,191	523	2,681
	- - - - Million board feet - - - -			
14 - 18	483	730	204	1,417
20 - 24	299	424	78	801
26 & over	149	560	28	737
Total bd.ft.	931	1,714	310	2,955

DISTRIBUTION OF SWEETGUM
IN SOUTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot containing at least one sweetgum tree 18 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



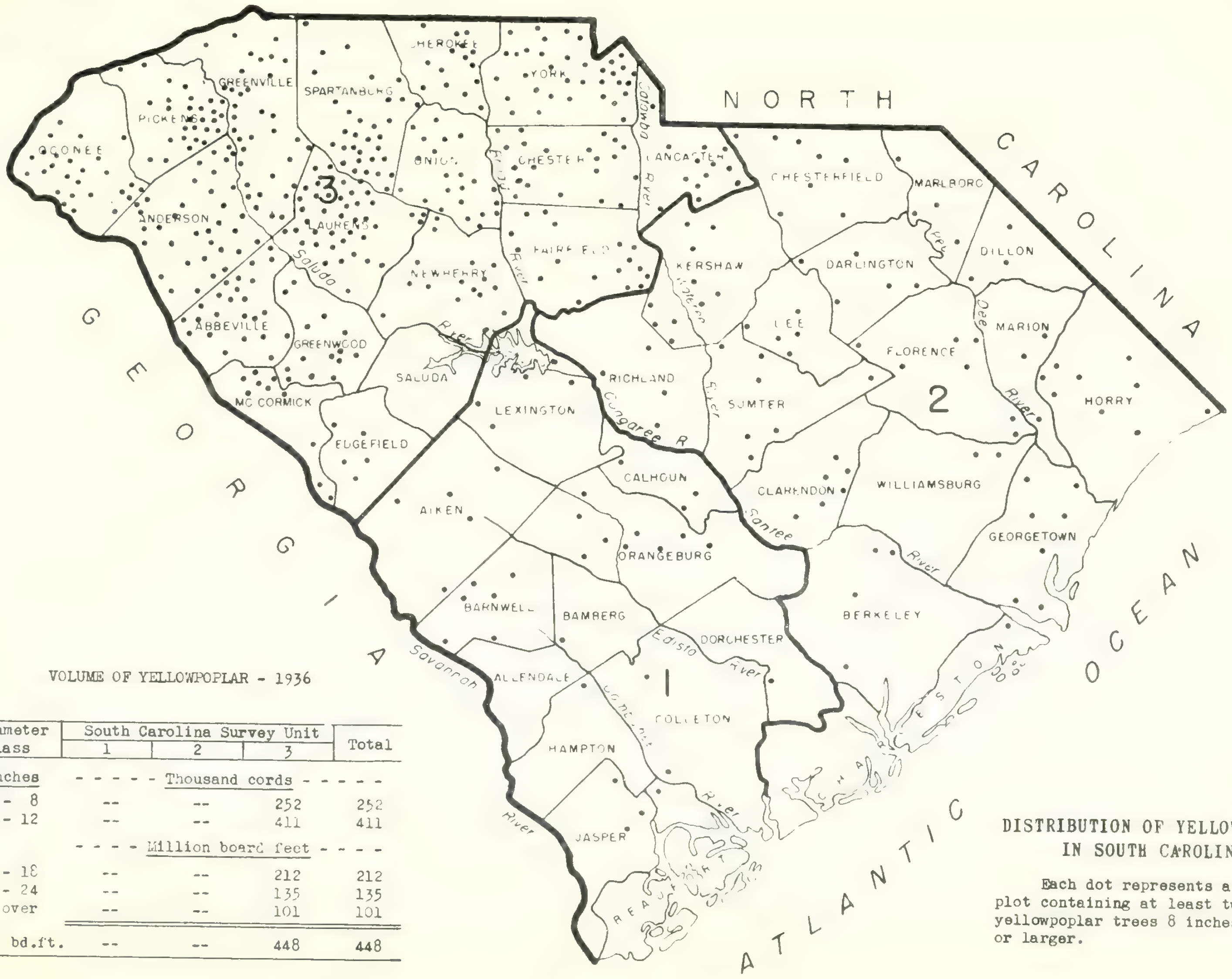
VOLUME OF BLACKGUM - 1936

Diameter class	South Carolina Survey Unit 1	2	3	Total
Inches	- - - - - Thousand cords - - - - -			
6 - 8	1,784	2,060	94	3,938
10 - 12	2,230	3,216	108	5,554
	- - - - Million board feet - - - -			
14 - 18	633	945	22	1,600
20 - 24	281	381	4	666
26 & over	80	178	2	260
Total bd.ft.	994	1,504	28	2,526

DISTRIBUTION OF BLACKGUM
IN SOUTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot containing at least one sound blackgum tree 18 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



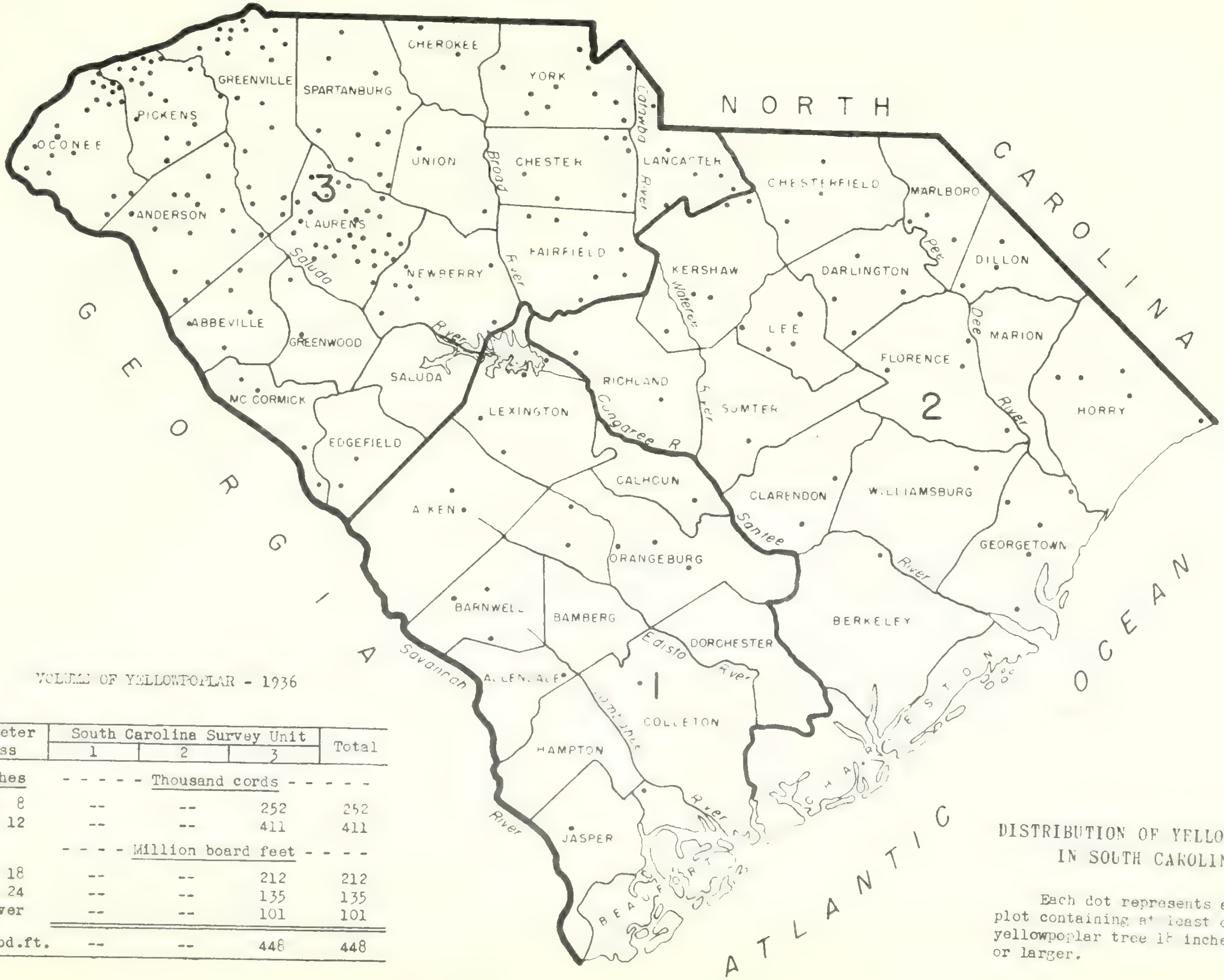
DISTRIBUTION OF YELLOWPOPLAR IN SOUTH CAROLINA

Each dot represents a $\frac{1}{4}$-acre plot containing at least two sound yellowpoplar trees 8 inches d.b.h. or larger.

VOLUME OF YELLOWPOPLAR - 1936

Diameter class	South Carolina Survey Unit			Total
	1	2	3	
Inches	- - - - - Thousand cords - - - - -			
6 - 8	--	--	252	252
10 - 12	--	--	411	411
	- - - - Million board feet - - - -			
14 - 18	--	--	212	212
20 - 24	--	--	135	135
26 & over	--	--	101	101
Total bd.ft.	--	--	448	448

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION



VOLUME OF YELLOWPOPLAR - 1936

Diameter class	South Carolina Survey Unit 1	2	3	Total
Inches	- - - - -	Thousand cords	- - - - -	
6 - 8	--	--	252	252
10 - 12	--	--	411	411
	- - - -	Million board feet	- - - -	
14 - 18	--	--	212	212
20 - 24	--	--	135	135
26 & over	--	--	101	101
Total bd.ft.	--	--	448	448

DISTRIBUTION OF YELLOWPOPLAR IN SOUTH CAROLINA

Each dot represents a ¼-acre plot containing at least one sound yellowpoplar tree 14 inches d.b.h. or larger.

FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION

FOREST SURVEY RELEASE NO. 10 SEPTEMBER 15, 1942

THE DISTRIBUTION OF COMMERCIAL FOREST TREES IN VIRGINIA

by

T. C. Evans
Associate Silviculturist

A FOREST SURVEY PROGRESS REPORT

J. W. Cruikshank, Regional Survey Director

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

Appalachian Forest Experiment Station
R. E. McArdle, Director
Asheville, N. C.

PREFACE

Through the McSweeny-McNary Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act, and each of the 12 Regional Forest Experiment Stations is responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station, Asheville, North Carolina.

The work of the Survey is divided into 5 major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of timber on these lands.

2. Growth. Determination of the current rate of timber growth.

3. Drain. Determination of the amount of industrial and domestic wood used, and the total loss resulting from fire, insects, disease, suppression, and other causes.

4. Requirements. Determination of the current and probable future requirements for forest products by all classes of consumers.

5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis for public and private policies and plans of forest land use and management.

This progress report presents information on one part of the inventory phase of the Survey and deals specifically with the geographic distribution of the more important commercial forest trees in Virginia.

The report is made possible through the assistance received from the personnel of the Work Projects Administration. Particular credit is due Mr. T. A. Lindsey of the Work Projects staff. The preparation of the maps from the basic field data was official project 165-2-32-94.

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  Yellowpoplar, 10" d.b.h. and larger 31
  Yellowpoplar, 16" d.b.h. and larger 32

A detailed description of the forest resource and industries will be contained in forthcoming unit reports for the Coastal Plain, Piedmont, and Mountain areas of Virginia.

THE DISTRIBUTION OF COMMERCIAL FOREST TREES IN VIRGINIA

The geographic distribution of forest tree species and sizes is important to wood-using industries, particularly when their effort is directed toward the production of war materials. Both established plants and prospective industries must know the location of species and sizes suitable to their needs if they are to concentrate wood procurement activities effectively.

Maps included in this report are designed to show the occurrence of selected commercial species and sizes so as to roughly locate areas of concentration. For example, in Virginia, sugar maple sixteen inches or larger in diameter is confined to the mountains and is found in some concentration in only two small areas, one in the adjacent Buchanan and Dickenson Counties, the other in Highland County. Industries equipped with similar information for a number of timber species may lessen considerably the time and cost of wide reconnaissance for their timber supply.

CONSTRUCTION OF MAPS

The procedure used by the Forest Survey is to establish one-quarter-acre sample plots at intervals of one-eighth mile along parallel compass lines, which are spaced at ten-mile intervals and extend across the five units into which the State is divided (fig. 1). The maps included here are based upon data recorded for over 31,000 such plots established in 1940. On each plot, representing approximately 800 acres, the required information

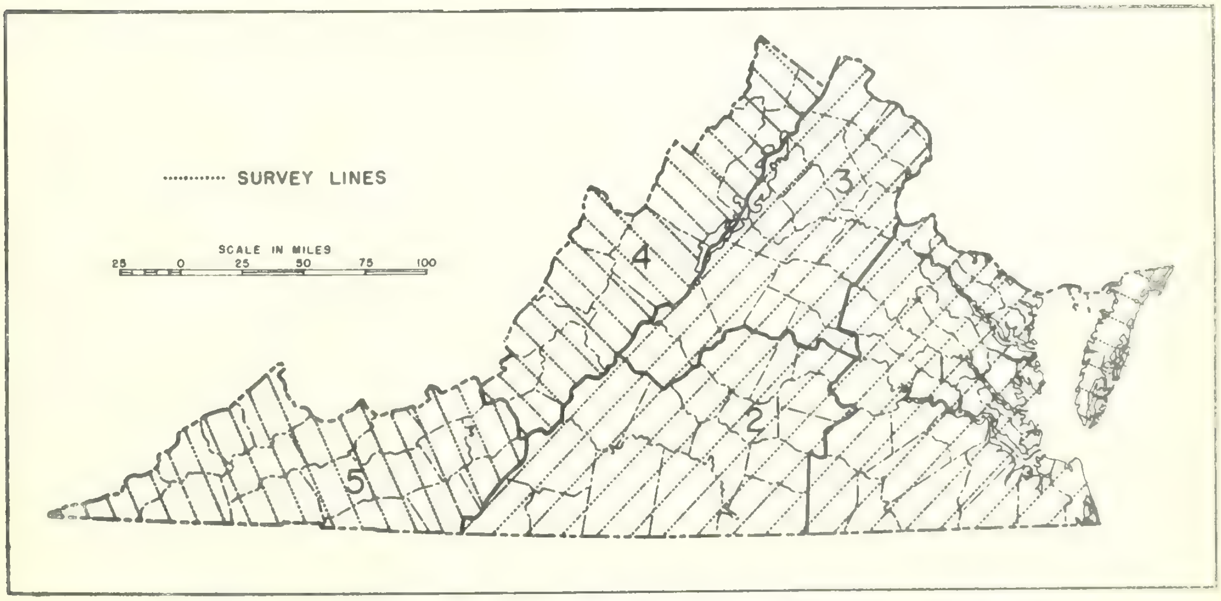


FIGURE 1 — APPROXIMATE LOCATION OF SURVEY LINES IN VIRGINIA

included a brief description of the stand, and a tally of the species, number, and sizes of all trees one inch and larger in diameter at breast height.

This procedure provides an accurate description of each forest plot, and a dependable measure of commercial concentration over large areas, but ignores many local concentrations which, by nature of the sampling technique, could not be studied. Consequently, the maps are not reliable for locating timber on small ownerships.

On each map, the total volume in sound trees is shown by diameter class for each Survey unit, and for the State. The volume of under-sawlog-size material (softwoods 5.0-9.9 inches and hardwoods 5.0-13.0 inches in diameter) is shown in cords, and the volume of saw timber in board feet as measured by the International $\frac{1}{4}$-inch rule, a close approximation to green lumber tally.

On the maps showing the distribution of loblolly, shortleaf, and Virginia pines, each dot represents a plot upon which the indicated species predominates. For example, on the map (page 24) for loblolly pine, each dot locates a plot in the loblolly pine type, in which loblolly pine is the predominant species. Other species may occur, but not in sufficient number to influence the type classification.

Maps for species other than loblolly, shortleaf, and Virginia pines show the occurrence of specified minimum sizes of the designated species. Each dot on the map for white pine (page 27), for example, represents a plot on which there was at least one sound white pine 16.0 inches or larger in diameter. Since the minimum size is not constant for all species, each map bears its own legend showing the class of material plotted on it.

THE FORESTS OF VIRGINIA

Species

Excluding 235,900 acres of public forest area reserved from cutting, and 184,400 acres of non-commercial land incapable of producing merchantable timber, the forests of Virginia occupy over 14 million acres, 56 percent of the total land area. Loblolly pine is the most abundant species, aggregating over seven billion board feet of merchantable volume, 29 percent of the total for all species, and dominating the forest area over much of the Coastal Plain. Shortleaf pine, second in abundance, occurs throughout the State, but predominates only in the Piedmont. Even here, to the north and west it gives way to the less desirable but more aggressive Virginia pine, the third ranking softwood.

Over most of the area a great variety of hardwoods are mixed with the pines, and constitute nearly half of the total board-foot volume. Sweetgum and black tupelo, with 76 percent of their volume in the Coastal Plain, are second only to the widely distributed oaks which comprise nearly six billion board feet, and yellowpoplar, two billion board feet. In sound chestnut, confined to the mountains and foothills, there are three-quarters of a billion feet of saw timber, and an additional six million cords of non-sawtimber material.

Forest Types

The hardwood types, extending over 8.2 million acres, 57 percent of the total forest area, are concentrated in the northern Piedmont and mountains, where they dominate respectively 62 and 77 percent of the forest. The upland hardwood type, covering a wide variety of hardwood species in mixture, occupies nearly seven million acres, or about 46 percent of the total forest area. While nearly half of this is in the mountain units, the type is found throughout the State. Even in the predominantly pine Coastal Plain, it extends over 23 percent of the forest, and is secondary only to the loblolly pine type. The bottomland hardwood type, found chiefly in the swamps and river bottoms of the Coastal Plain, and the cove and northern hardwoods of the mountains and foothills comprise the remaining 1.5 million acres of hardwood forest.

Among the pine types, extending over 6.2 million acres, the loblolly pine, confined to the Coastal Plain, and the shortleaf and Virginia pine types, concentrated in the Piedmont, each occupy about two million acres. The less extensive white pine and hemlock types of the mountains occupy only 236,100 acres.

Forest Conditions

Although less than three percent of the forest area is characterized by old-growth timber, over seven million acres bear sawlog-size stands ranging in volume from an average of 1,300 board feet per acre for the shortleaf pine type in the northern mountains to over 5,500 board feet per acre for the comparatively dense loblolly pine stands of the Coastal Plain. Over three million acres, 42 percent, of this total is in the upland hardwood type, averaging 2,440 board feet per acre.

Of the 6.6 million acres in the under-sawlog-size stands, 53 percent is in the upland hardwood type, and nearly 16 percent in the Virginia pine type. The Coastal Plain contains the lowest proportionate area, 33 percent, in these young stands. Only 703,900 acres were classified as reproduction, more than half of which is located in the Piedmont. No areas were classified as clearcut, but the stocking over much of the area is very low, probably not averaging over 45-50 percent of the volume desirable under reasonable forest productivity.

DISTRIBUTION MAPS OF COMMERCIAL FOREST TREES

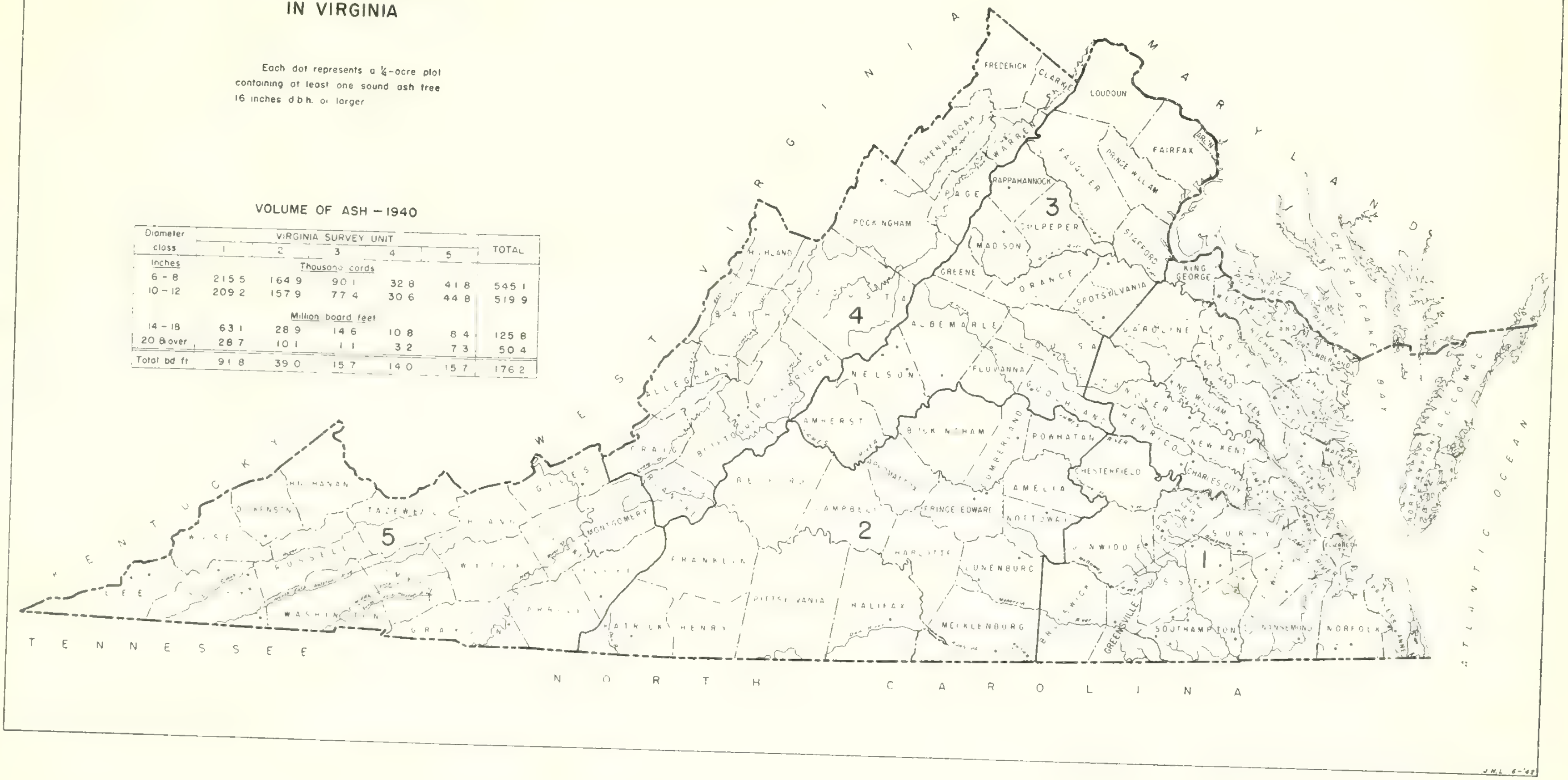
Map	Tree species included
Ash	Ash
Basswood	Basswood
Beech	Beech
Birch	Black, yellow, and river birch
Black locust	Black locust
Black tupelo	Black and water tupelo
Chestnut	Chestnut
Cypress	Baldcypress and pondcypress
Hemlock	Hemlock
Hickory	Bitternut, water, shagbark, mockernut, and pignut hickory
Maple, red	Red maple, silver maple, and box elder
Maple, sugar	Sugar maple
Oak, chestnut	Chestnut oak
Oak, northern red	Northern red oak
Oak, post	Post oak and overcup oak
Oak, red	Black, scarlet, pin, water, willow, and southern red oak
Oak, white	White oak, and swamp chestnut oak
Pine, loblolly	Loblolly pine
Pine, shortleaf	Shortleaf, pitch, and table mountain pine
Pine, Virginia	Virginia pine
Pine, white	White pine
Redcedar	Eastern redcedar
Sweetgum	Sweetgum
Yellowpoplar	Yellowpoplar

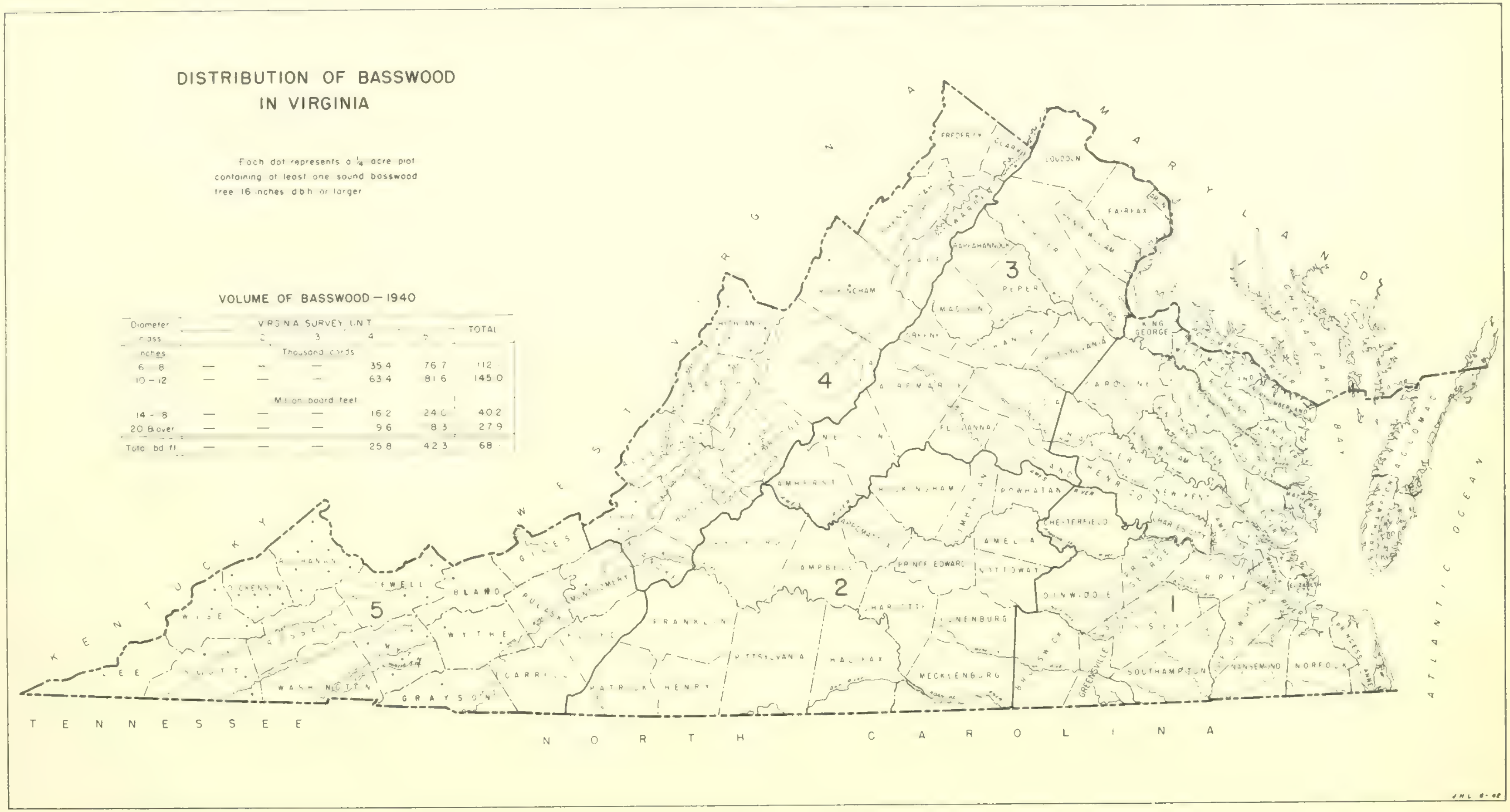
DISTRIBUTION OF ASH IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound ash tree 16 inches d.b.h. or larger

VOLUME OF ASH – 1940

Diameter class	VIRGINIA SURVEY UNIT					TOTAL
	1	2	3	4	5	
Inches			Thousand cords			
6 – 8	215.5	164.9	90.1	32.8	41.8	545.1
10 – 12	209.2	157.9	77.4	30.6	44.8	519.9
			Million board feet			
14 – 18	63.1	28.9	14.6	10.8	8.4	125.8
20 & over	28.7	10.1	1.1	3.2	7.3	50.4
Total bd ft	91.8	39.0	15.7	14.0	15.7	176.2





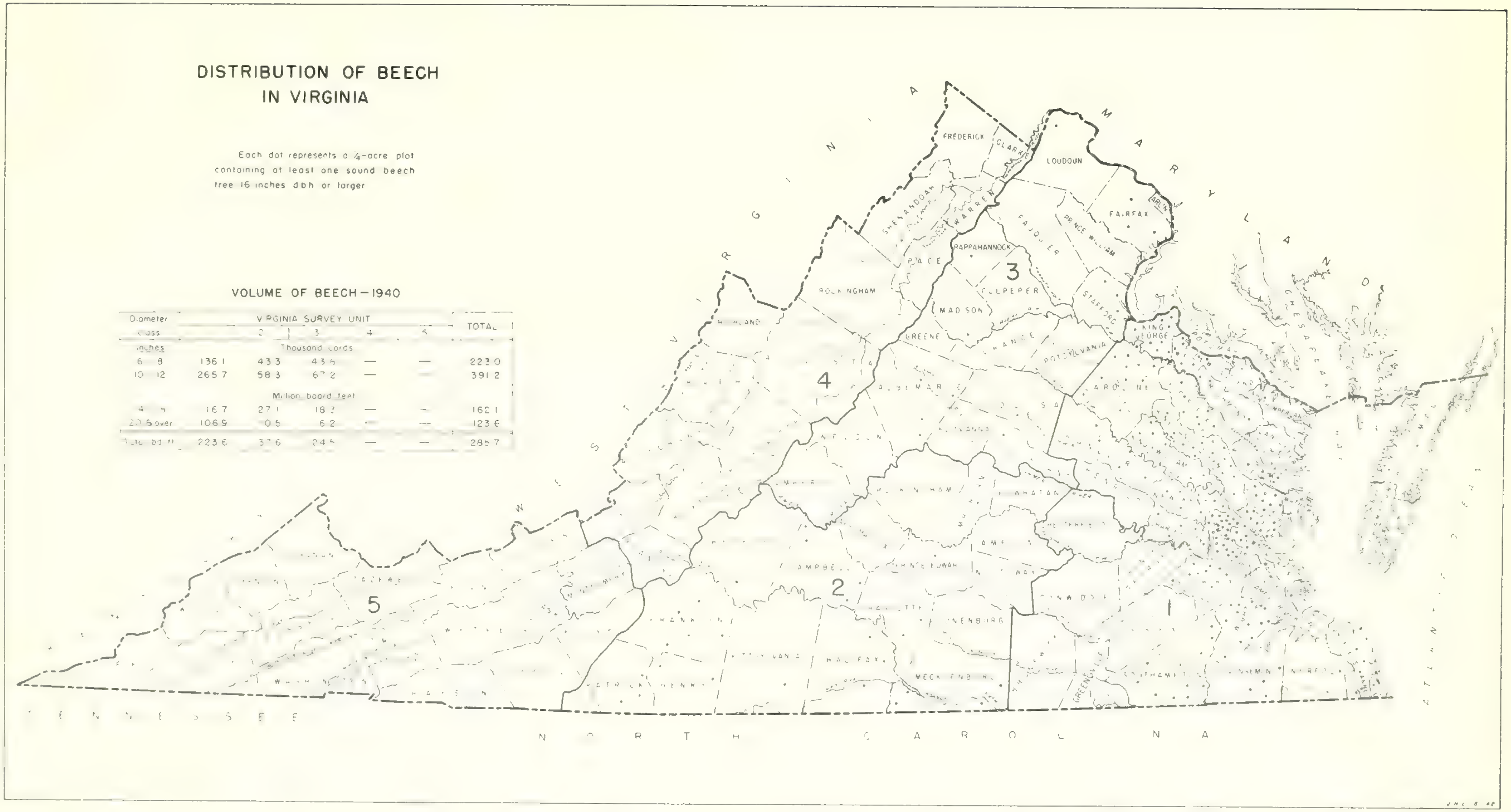
DISTRIBUTION OF BASSWOOD IN VIRGINIA

Each dot represents a ¼ acre plot containing at least one sound basswood tree 16 inches d.b.h. or larger

VOLUME OF BASSWOOD—1940

Diameter class	Virginia Survey Unit 1	2	3	4	5	TOTAL
Inches			Thousand cords			
6 – 8	—	—	—	35.4	76.7	112
10 – 12	—	—	—	63.4	81.6	145.0
			Million board feet			
14 – 18	—	—	—	16.2	24.0	40.2
20 & over	—	—	—	9.6	8.3	27.9
Total bd. ft.	—	—	—	25.8	42.3	68

J.H.L. 6-42

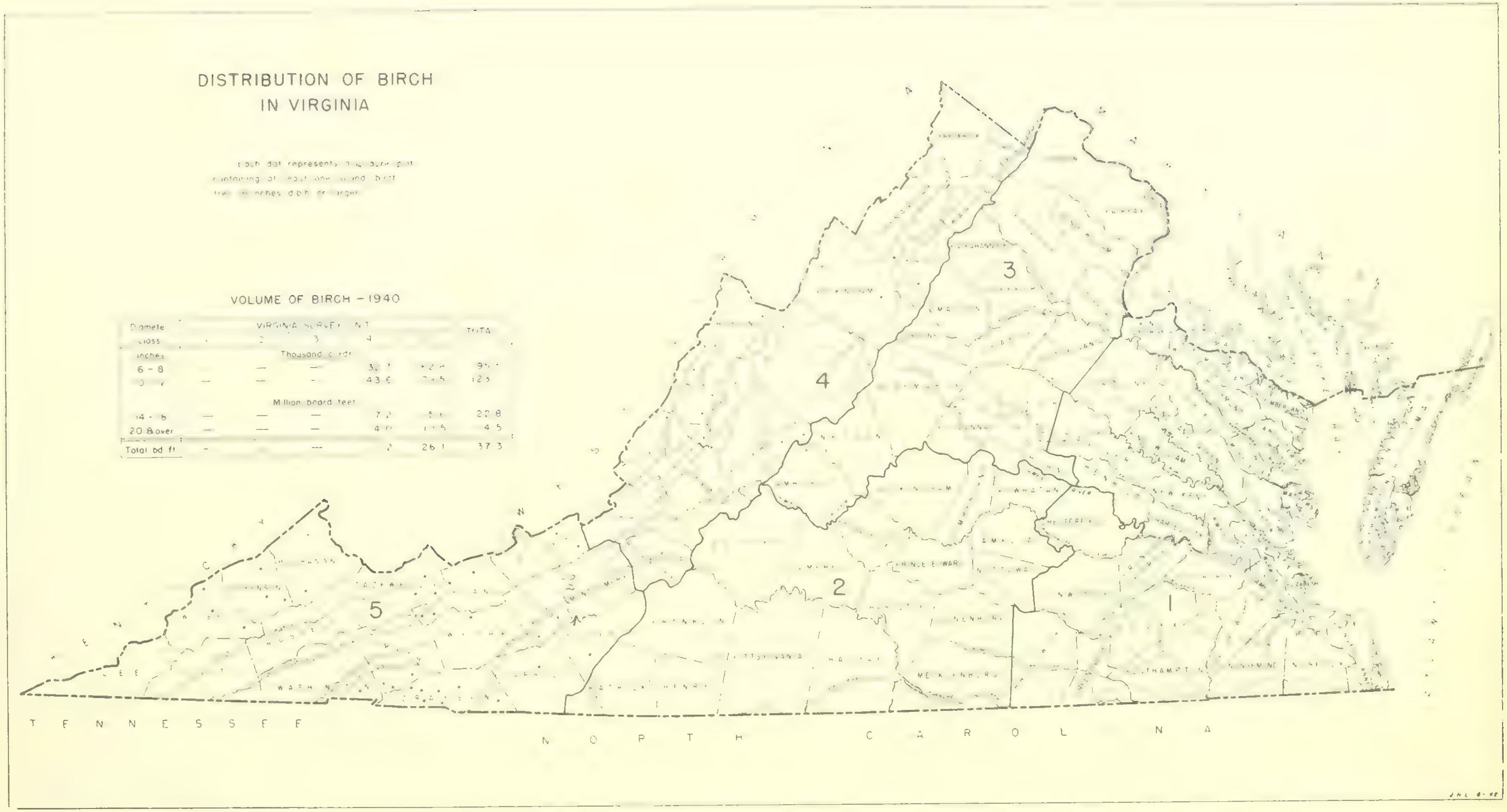


DISTRIBUTION OF BEECH IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound beech tree 16 inches d.b.h. or larger

VOLUME OF BEECH—1940

Diameter class	Virginia survey unit					TOTAL
		2	3	4	5	
Inches	Thousand cords					
6–8	136.1	43.3	43.6	—	—	223.0
10–12	265.7	58.3	67.2	—	—	391.2
	Million board feet					
14–20	116.7	27.1	18.3	—	—	162.1
22.0 & over	106.9	10.5	6.2	—	—	123.6
Total bd. ft.	223.6	37.6	24.5	—	—	285.7



DISTRIBUTION OF BIRCH IN VIRGINIA

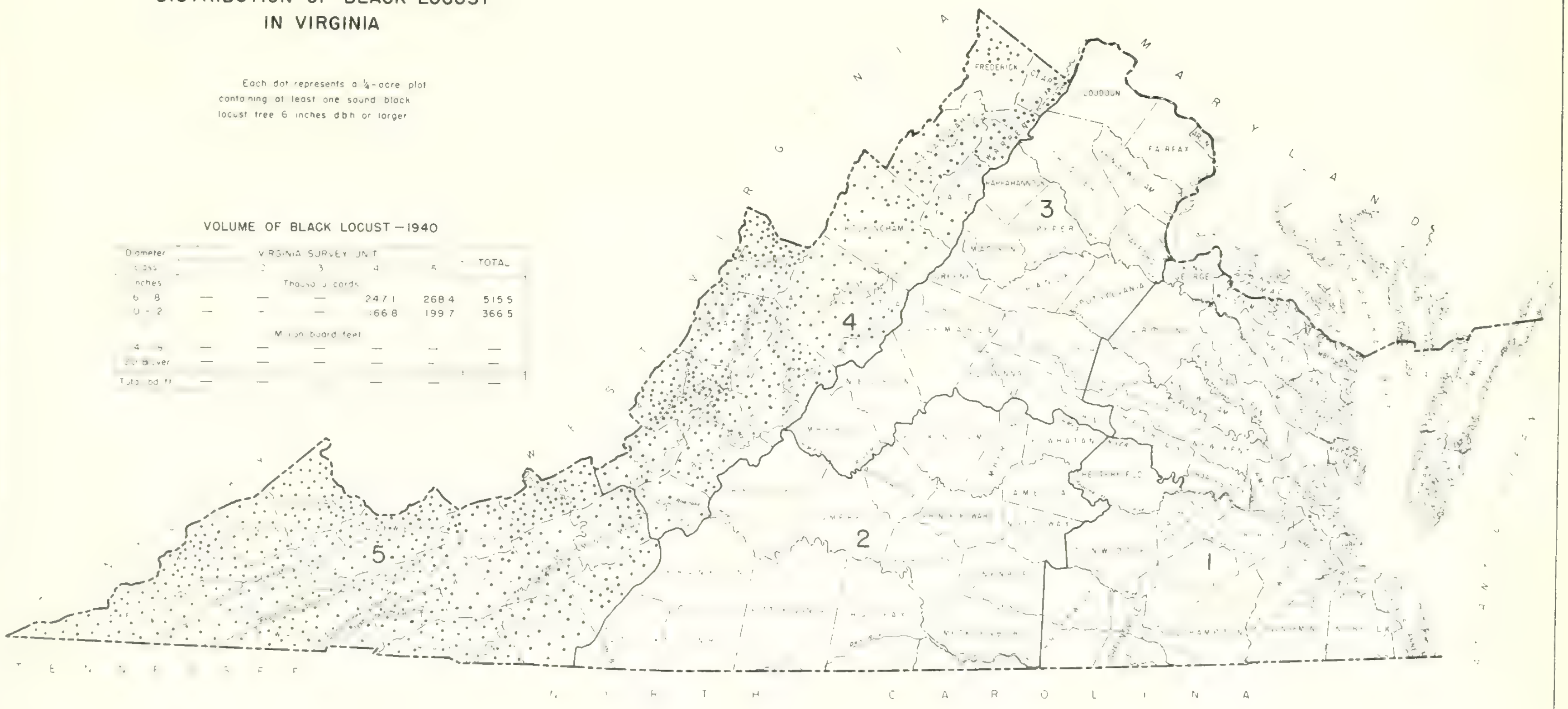
Each dot represents a ¼-acre plot containing at least one sound birch tree [illegible] inches d.b.h. or larger

VOLUME OF BIRCH – 1940

Diameter class inches	VIRGINIA SURVEY UNIT 1	2	3	4	5	TOTAL
	Thousand cords					
6 – 8	—	—	—	3[illegible]	[illegible]	9[illegible]
[illegible]	—	—	—	43.6	[illegible].5	12[illegible]
	Million board feet					
14 – [illegible]	—	—	—	7.2	5.[illegible]	[illegible]2.8
20 & over	—	—	—	4.0	[illegible].5	4.5
Total bd ft	—	—	—	[illegible]2	26.1	37.3

DISTRIBUTION OF BLACK LOCUST IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound black locust tree 6 inches d.b.h. or larger



VOLUME OF BLACK LOCUST—1940

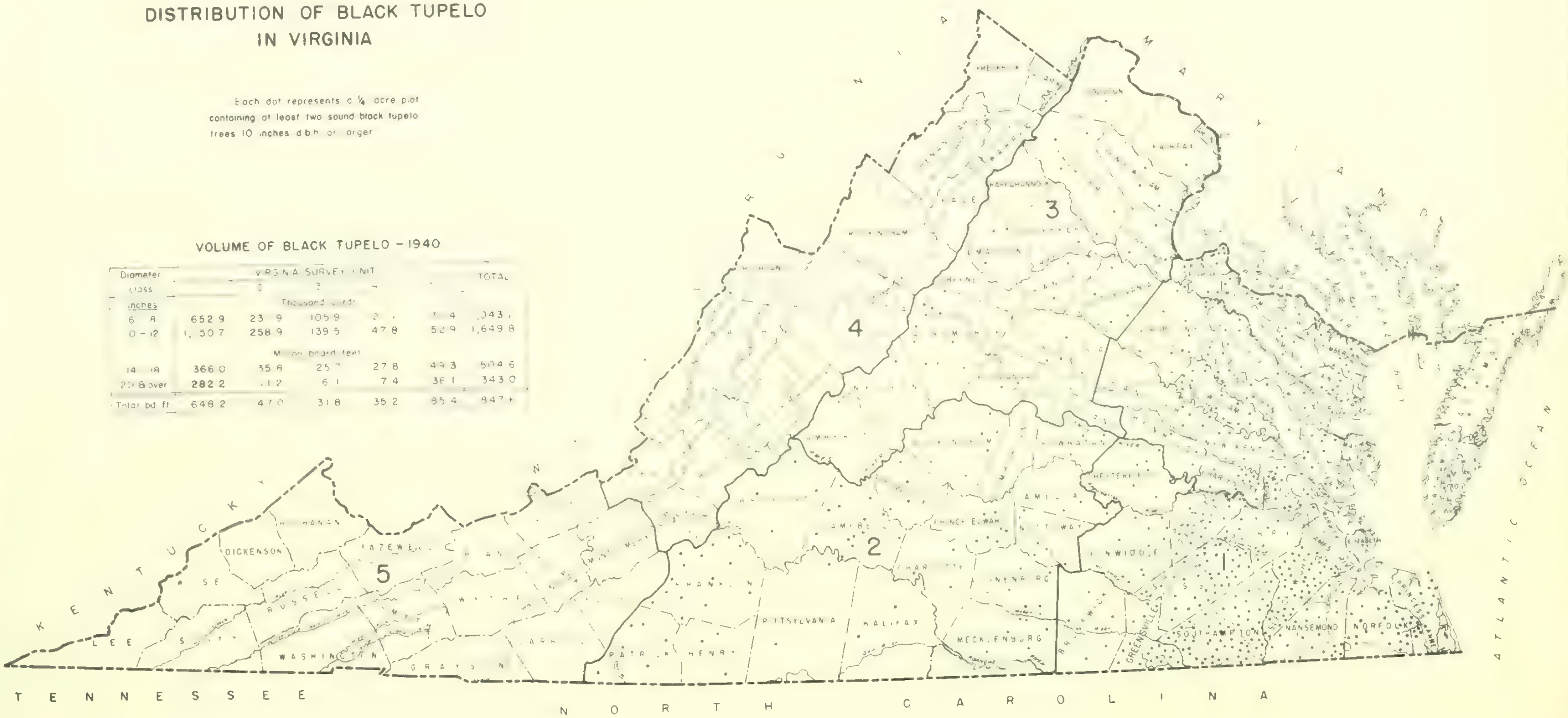
Diameter class	VIRGINIA SURVEY UNIT 1	2	3	4	5	TOTAL
Inches			Thousand cords			
6 - 8	—	—	—	247.1	268.4	515.5
10 - 12	—	—	—	166.8	199.7	366.5
			Million board feet			
14 - 18	—	—	—	—	—	—
20 and over	—	—	—	—	—	—
Total bd. ft.	—	—		—	—	—

DISTRIBUTION OF BLACK TUPELO IN VIRGINIA

Each dot represents a ¼ acre plot containing at least two sound black tupelo trees 10 inches d.b.h. or larger

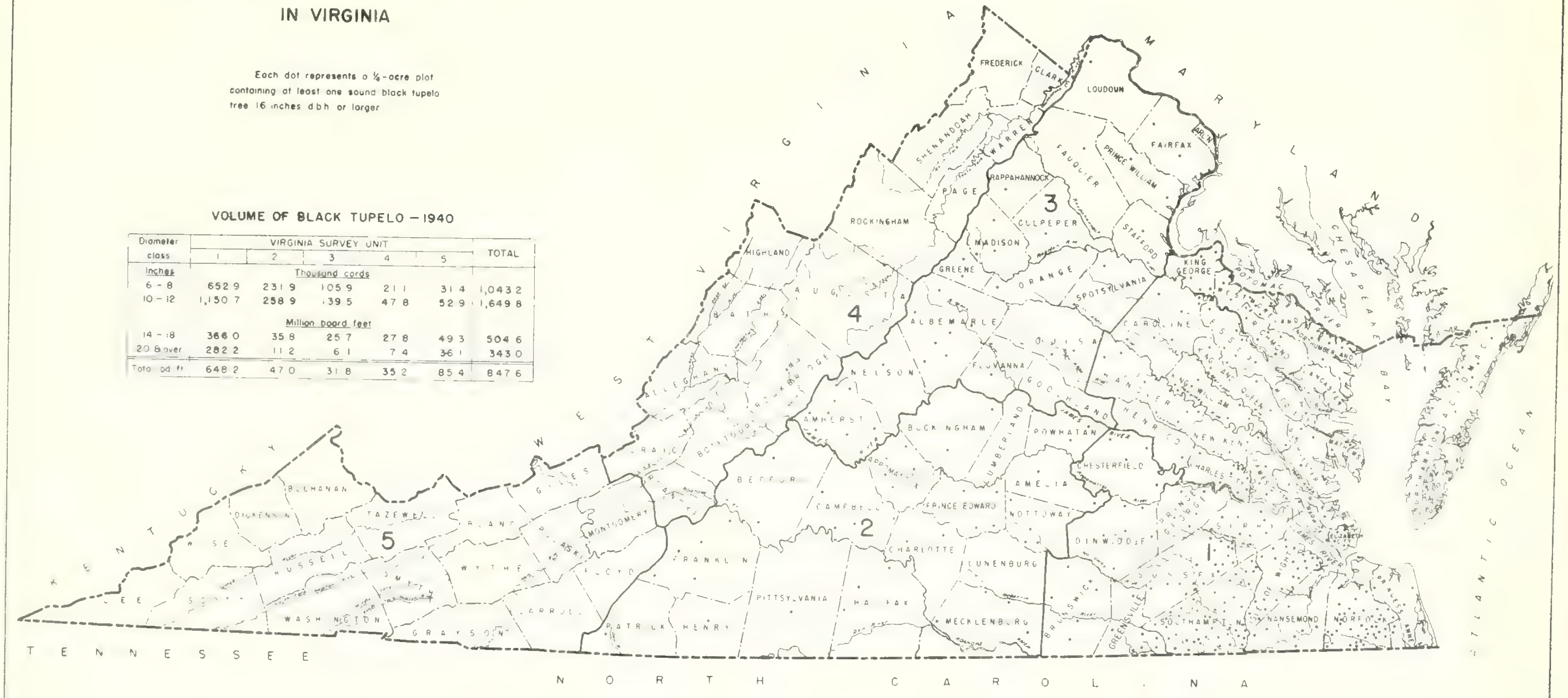
VOLUME OF BLACK TUPELO - 1940

Diameter class	VIRGINIA SURVEY UNIT					TOTAL
	1	2	3	4	5	
Inches	Thousand cords					
6 - 8	652.9	231.9	105.9	[illegible]	[illegible]	1,043.[illegible]
10 - 12	1,150.7	258.9	139.5	47.8	52.9	1,649.8
	Million board feet					
14 - 18	366.0	35.8	25.7	27.8	49.3	504.6
20 & over	282.2	11.2	6.1	7.4	36.1	343.0
Total bd. ft.	648.2	47.0	31.8	35.2	85.4	847.6



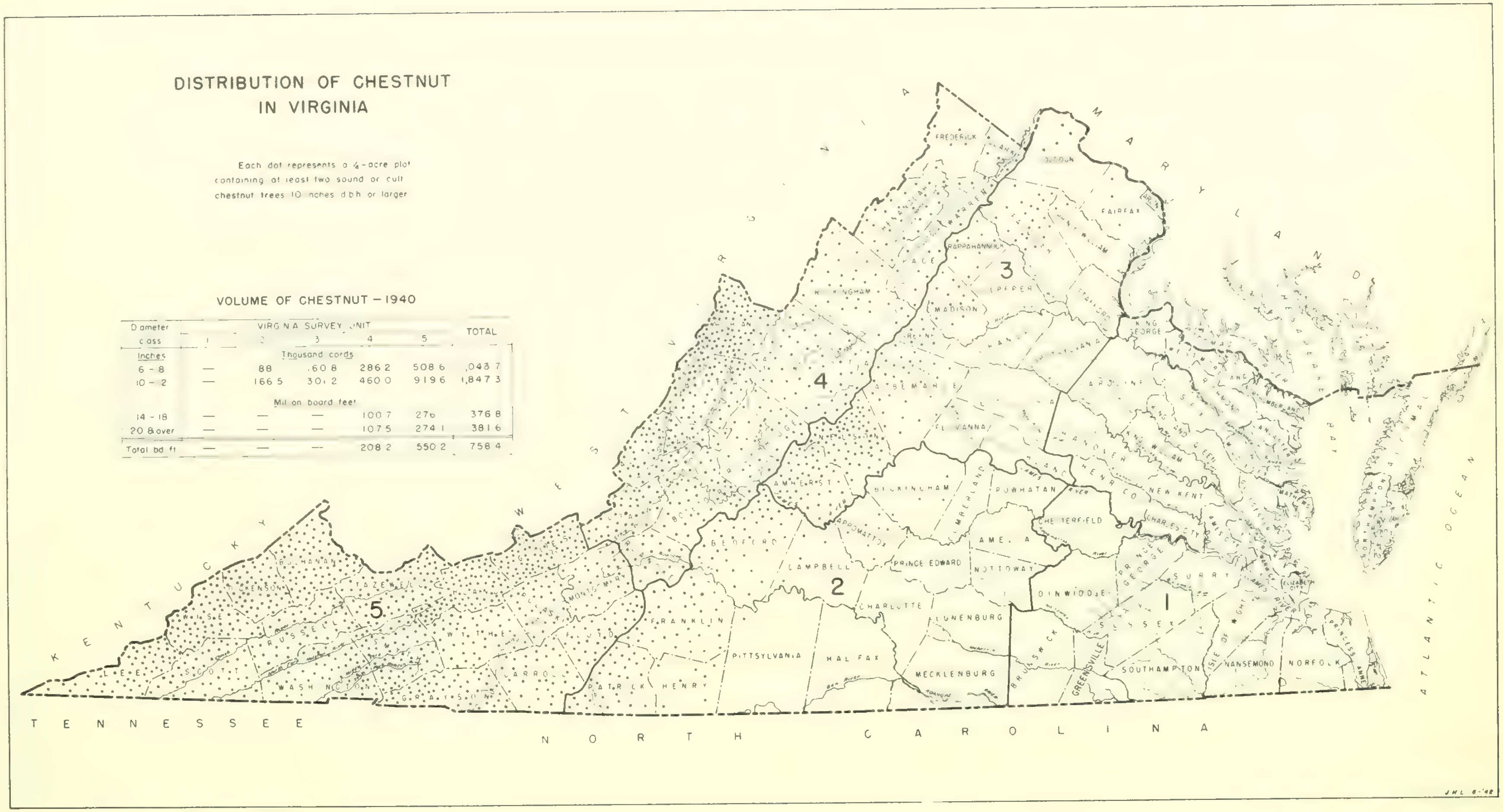
DISTRIBUTION OF BLACK TUPELO IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound black tupelo tree 16 inches d.b.h. or larger



VOLUME OF BLACK TUPELO – 1940

Diameter class	VIRGINIA SURVEY UNIT 1	2	3	4	5	TOTAL
Inches	Thousand cords					
6 – 8	652.9	231.9	105.9	21.1	31.4	1,043.2
10 – 12	1,150.7	258.9	139.5	47.8	52.9	1,649.8
	Million board feet					
14 – 18	366.0	35.8	25.7	27.8	49.3	504.6
20 & over	282.2	11.2	6.1	7.4	36.1	343.0
Total bd ft	648.2	47.0	31.8	35.2	85.4	847.6



DISTRIBUTION OF CHESTNUT IN VIRGINIA

Each dot represents a ¼-acre plot containing at least two sound or cull chestnut trees 10 inches d.b.h. or larger

VOLUME OF CHESTNUT – 1940

Diameter class	VIRGINIA SURVEY UNIT 1	2	3	4	5	TOTAL
Inches			Thousand cords			
6 - 8	—	88	160.8	286.2	508.6	1,043.7
10 - 12	—	166.5	301.2	460.0	919.6	1,847.3
			Million board feet			
14 - 18	—	—	—	100.7	276.1	376.8
20 & over	—	—	—	107.5	274.1	381.6
Total bd. ft.	—	—	—	208.2	550.2	758.4

DISTRIBUTION OF CHESTNUT IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound or cull chestnut tree 16 inches d.b.h. or larger

VOLUME OF CHESTNUT – 1940

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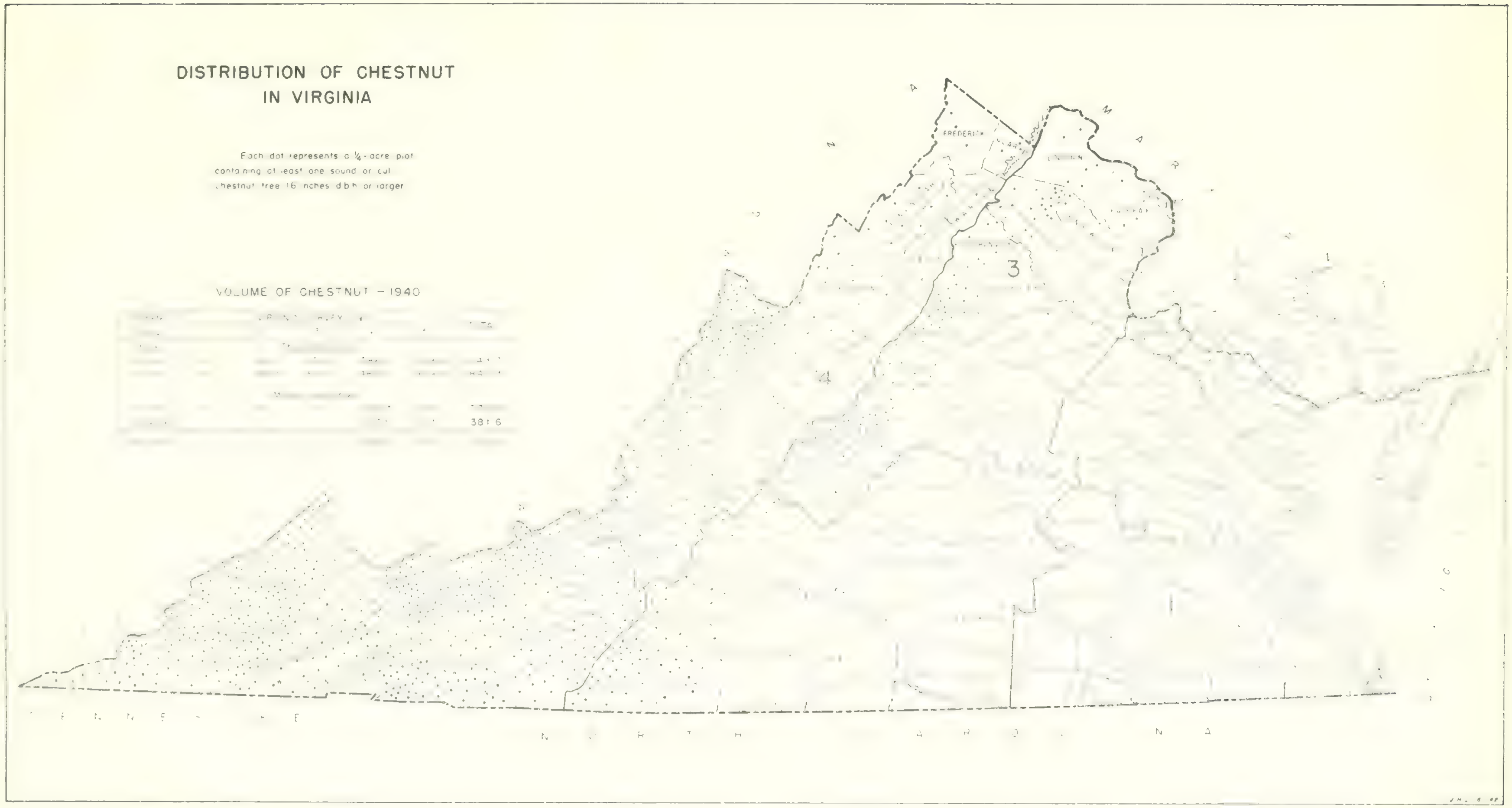
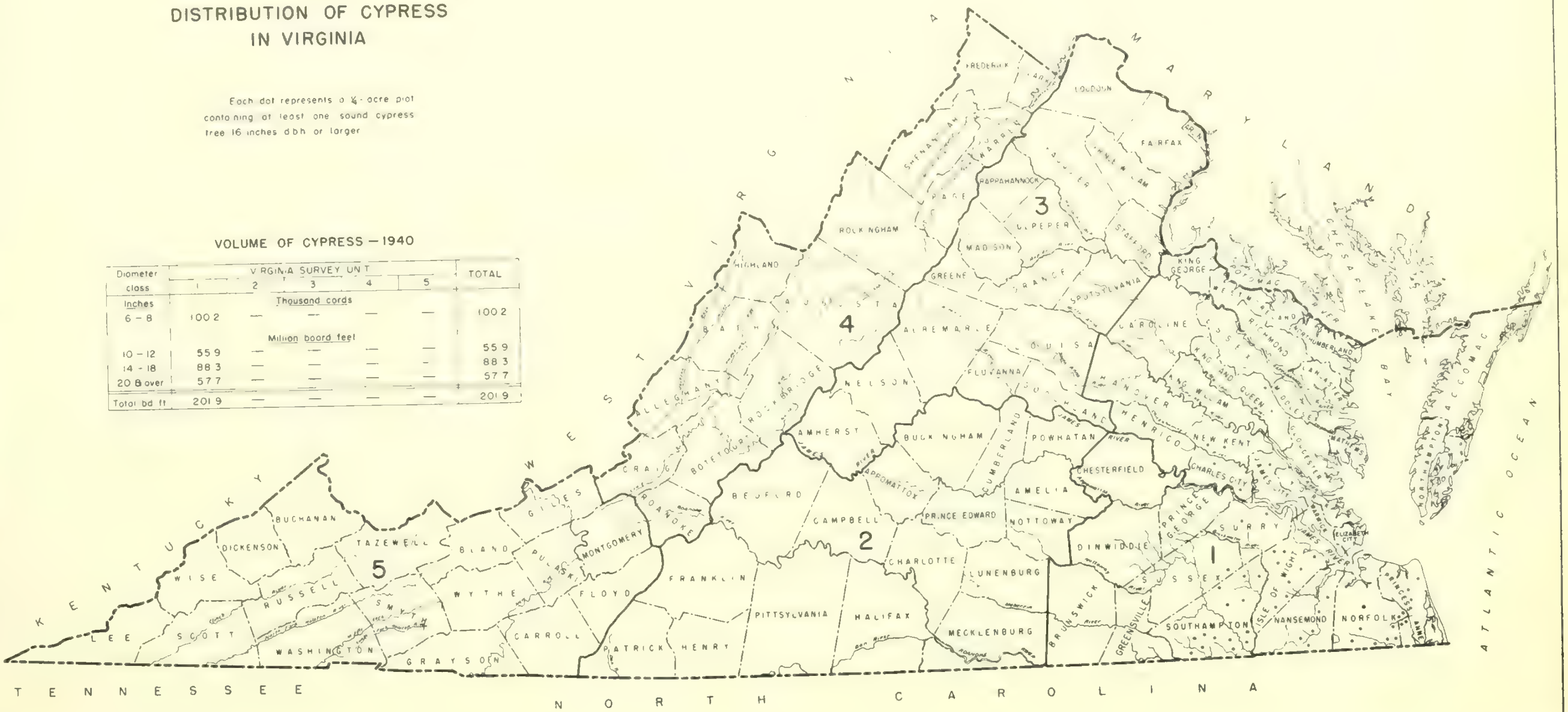


DISTRIBUTION OF CYPRESS IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound cypress tree 16 inches d.b.h. or larger

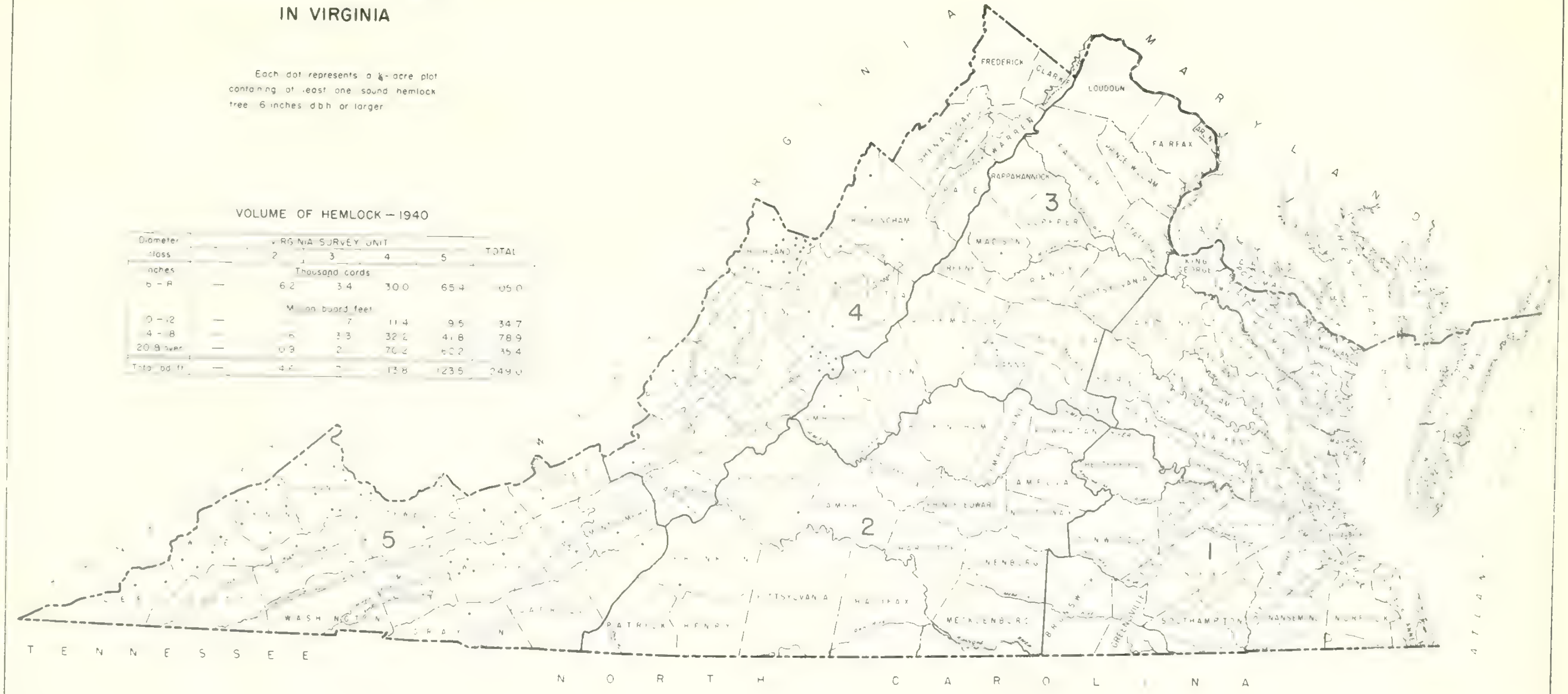
VOLUME OF CYPRESS—1940

Diameter class	Virginia survey unit 1	2	3	4	5	TOTAL
Inches			Thousand cords			
6 – 8	100.2	—	—	—	—	100.2
			Million board feet			
10 – 12	55.9	—	—	—	—	55.9
14 – 18	88.3	—	—	—	—	88.3
20 & over	57.7	—	—	—	—	57.7
Total bd ft	201.9	—	—	—	—	201.9



DISTRIBUTION OF HEMLOCK IN VIRGINIA

Each dot represents a ⅕-acre plot containing at least one sound hemlock tree 6 inches d.b.h. or larger

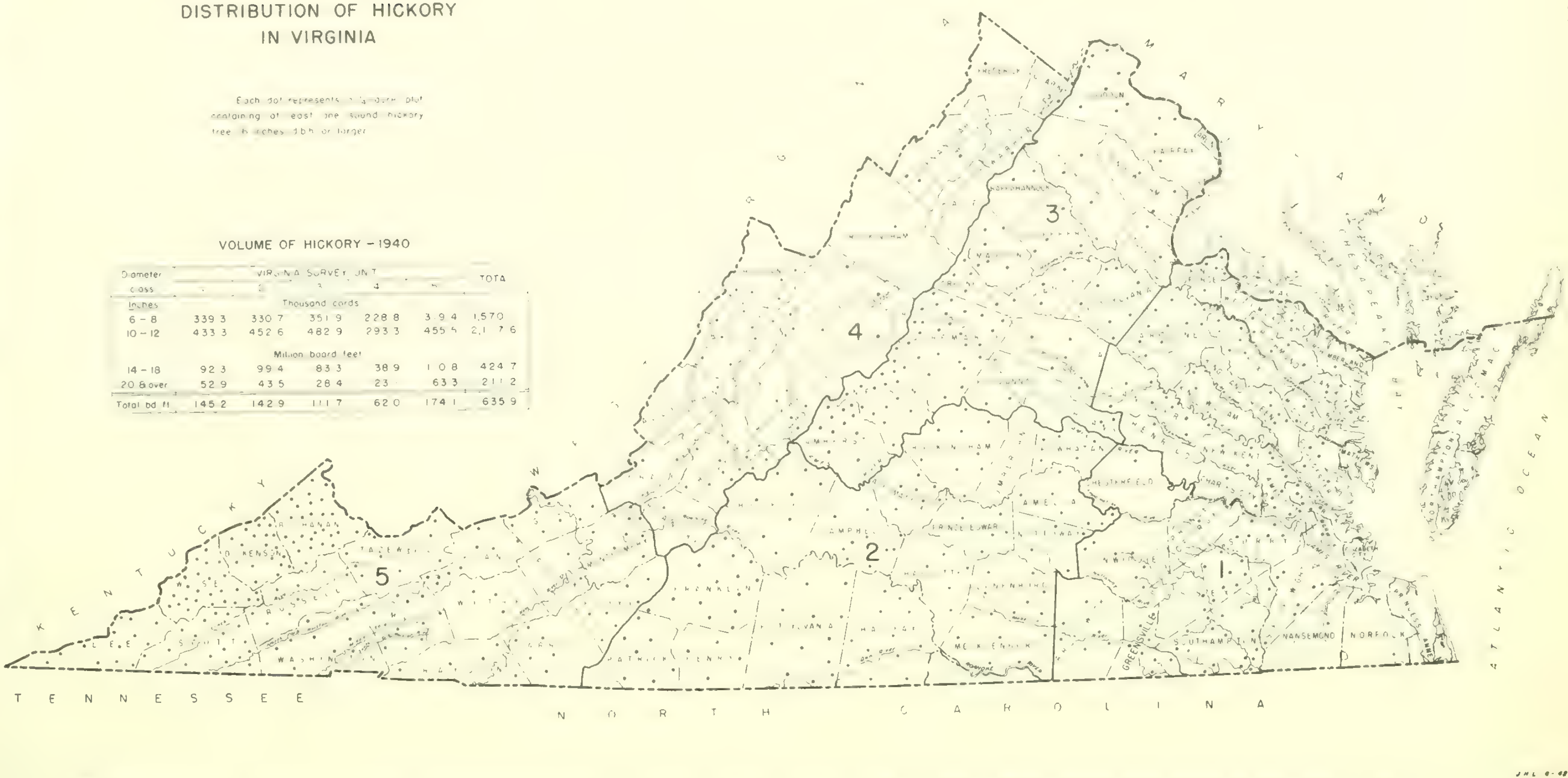


VOLUME OF HEMLOCK – 1940

Diameter class	VIRGINIA SURVEY UNIT					TOTAL
		2	3	4	5	
Inches	Thousand cords					
6 – 8	—	6.2	3.4	30.0	65.4	105.0
	Million board feet					
10 – 12	—	[illegible]	[illegible]	11.4	9.5	34.7
14 – 18	—	[illegible]	3.3	32.2	41.8	78.9
20 & over	—	0.9	[illegible]	70.2	62.2	135.4
Total bd. ft.	—	4.6	[illegible]	113.8	123.5	249.0

DISTRIBUTION OF HICKORY IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound hickory tree 6 inches d.b.h. or larger



VOLUME OF HICKORY – 1940

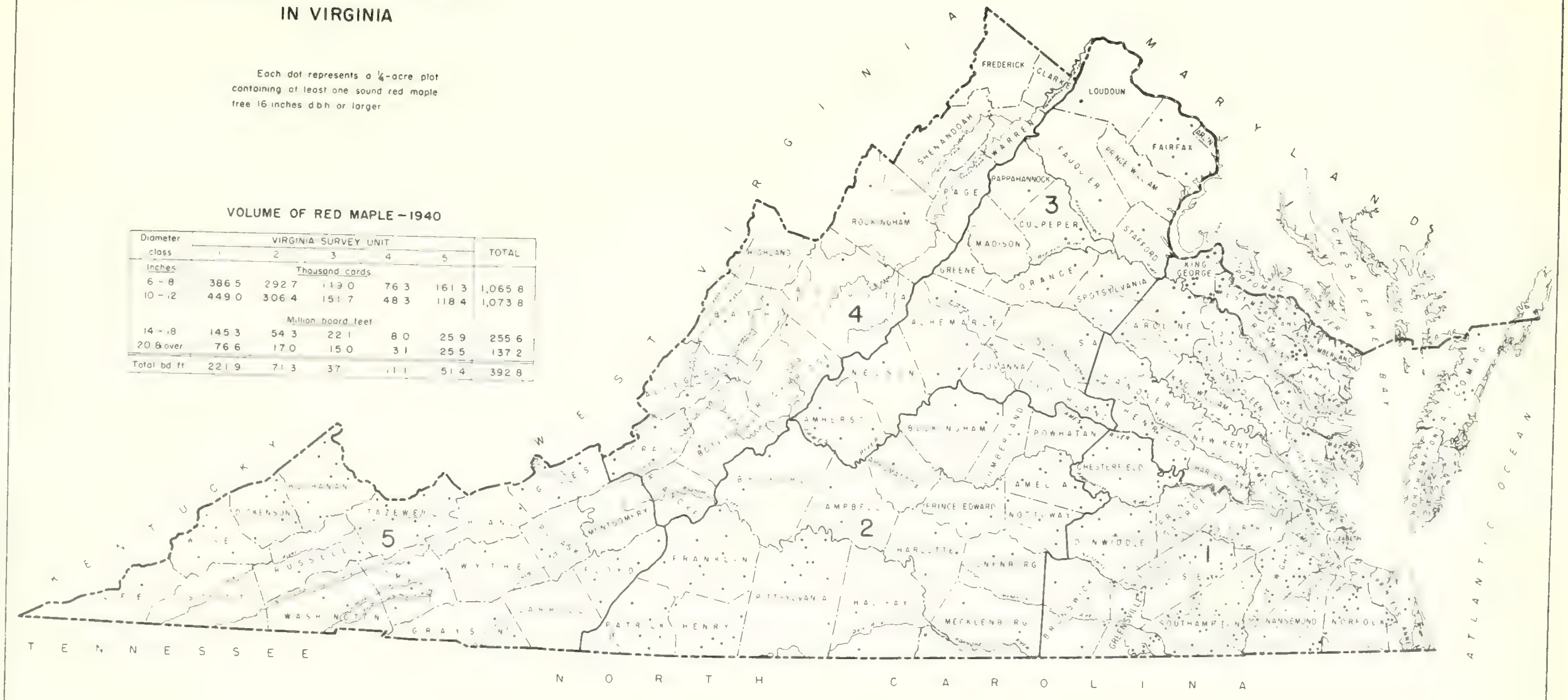
Diameter class	VIRGINIA SURVEY UNIT 1	2	3	4	5	TOTAL
Inches	Thousand cords					
6 – 8	339.3	330.7	351.9	228.8	319.4	1,570
10 – 12	433.3	452.6	482.9	293.3	455.5	2,117.6
	Million board feet					
14 – 18	92.3	99.4	83.3	38.9	110.8	424.7
20 & over	52.9	43.5	28.4	23.1	63.3	211.2
Total bd. ft.	145.2	142.9	111.7	62.0	174.1	635.9

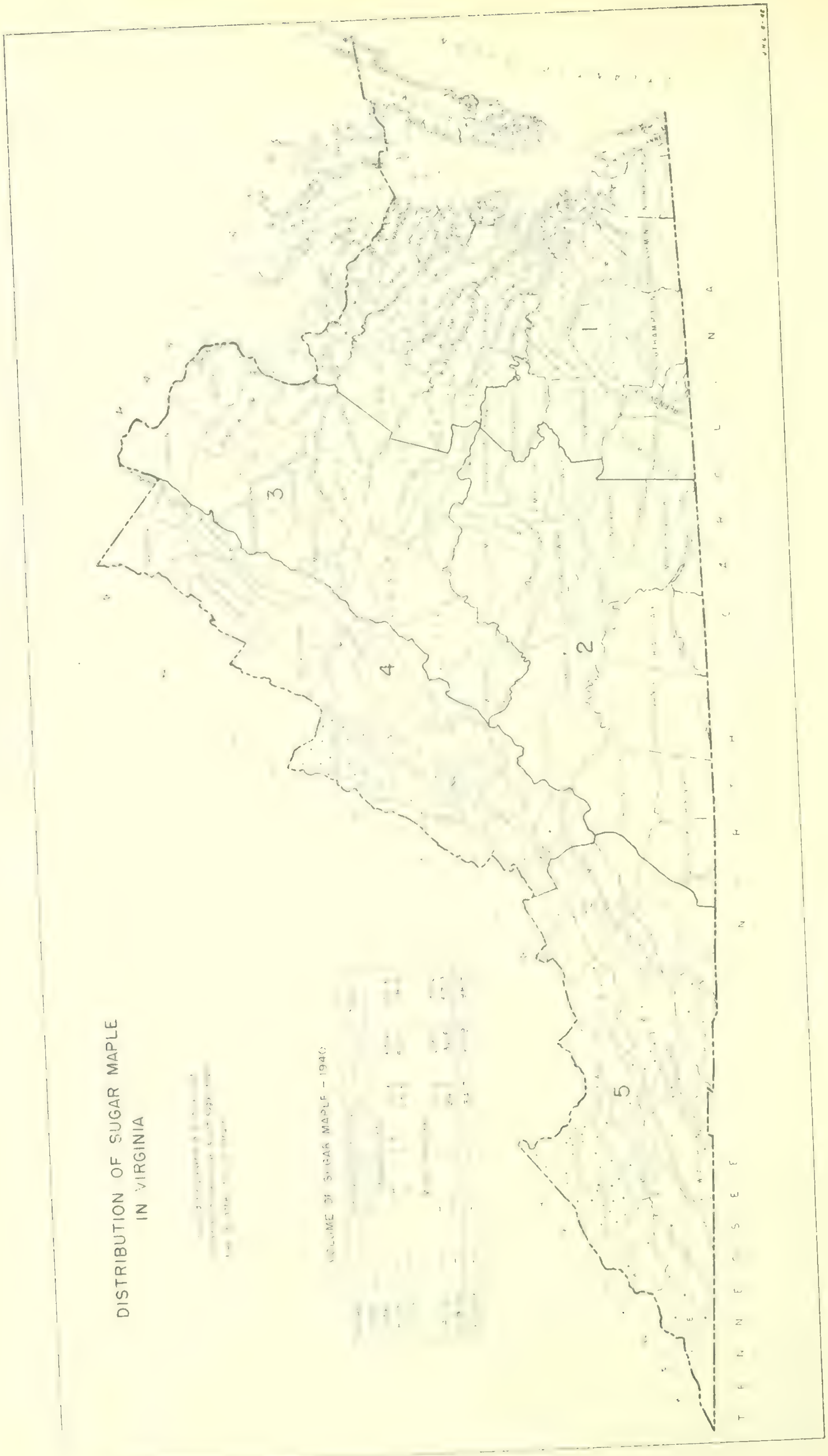
DISTRIBUTION OF RED MAPLE IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound red maple tree 16 inches d.b.h. or larger

VOLUME OF RED MAPLE – 1940

Diameter class	VIRGINIA SURVEY UNIT					TOTAL
	1	2	3	4	5	
Inches	Thousand cords					
6 – 8	386.5	292.7	149.0	76.3	161.3	1,065.8
10 – 12	449.0	306.4	151.7	48.3	118.4	1,073.8
	Million board feet					
14 – 18	145.3	54.3	22.1	8.0	25.9	255.6
20 & over	76.6	17.0	15.0	3.1	25.5	137.2
Total bd. ft.	221.9	71.3	37	11.1	51.4	392.8





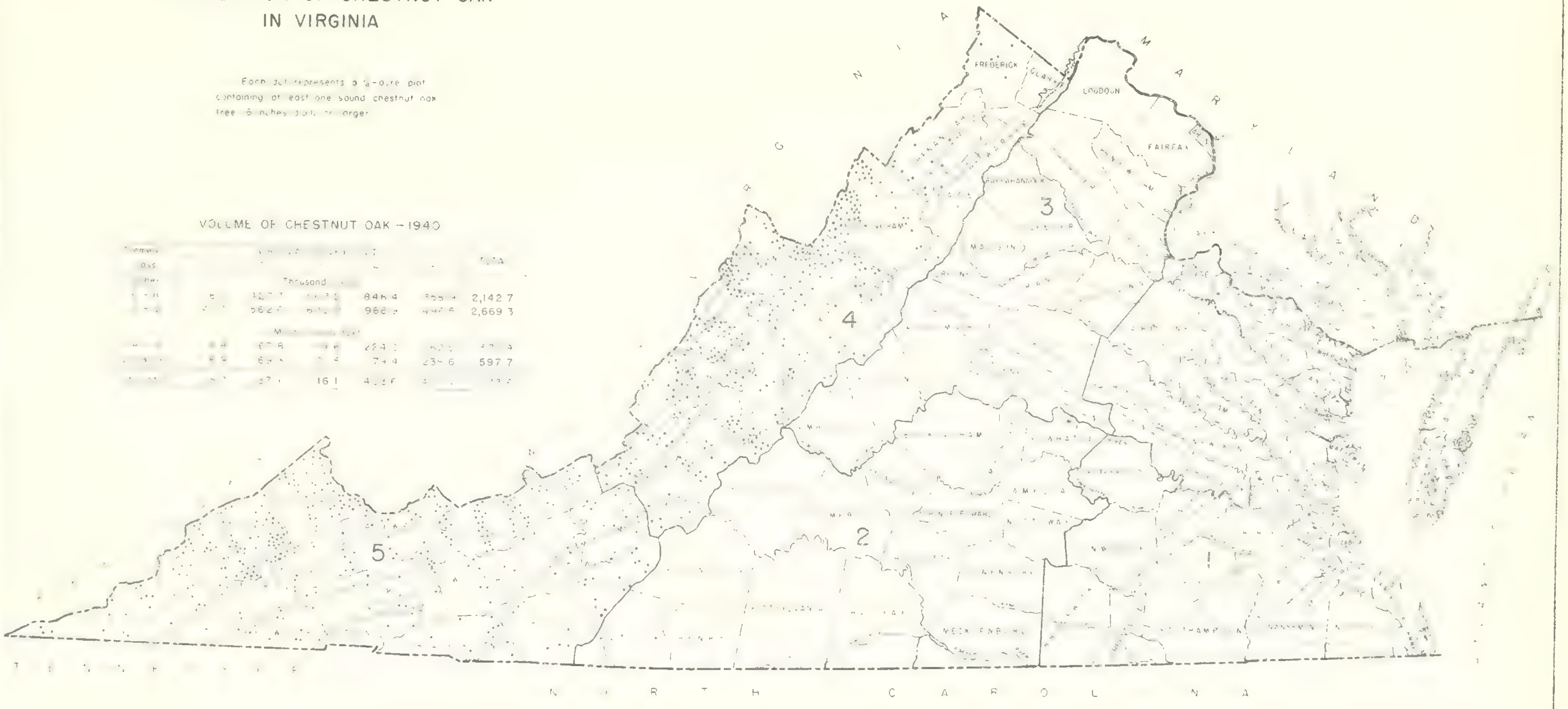
DISTRIBUTION OF SUGAR MAPLE IN VIRGINIA

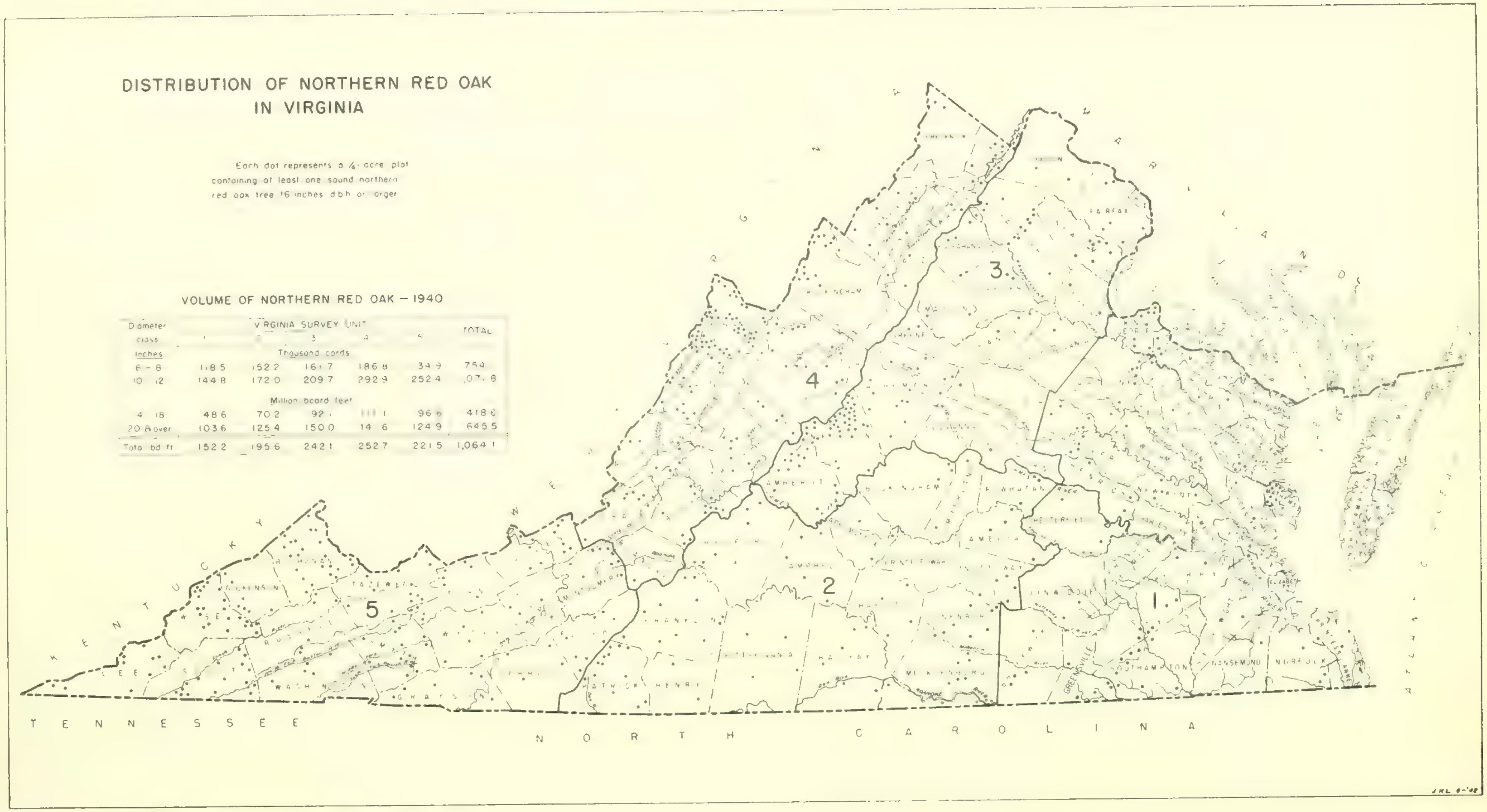
DISTRIBUTION OF CHESTNUT OAK IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound chestnut oak tree 5 inches d.b.h. or larger

VOLUME OF CHESTNUT OAK – 1940

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Total
		Thousand [illegible]				
[illegible]	5	127.7	[illegible]	846.4	355.4	2,142.7
[illegible]	[illegible]	562.6	[illegible]	962.3	449.6	2,669.3
		M[illegible]				
[illegible]	8.4	67.8	[illegible]	224.2	[illegible]	[illegible]
[illegible]	8.4	65.4	[illegible]	74.4	234.6	597.7
[illegible]	[illegible]	37.4	16.1	4[illegible]	[illegible]	[illegible]





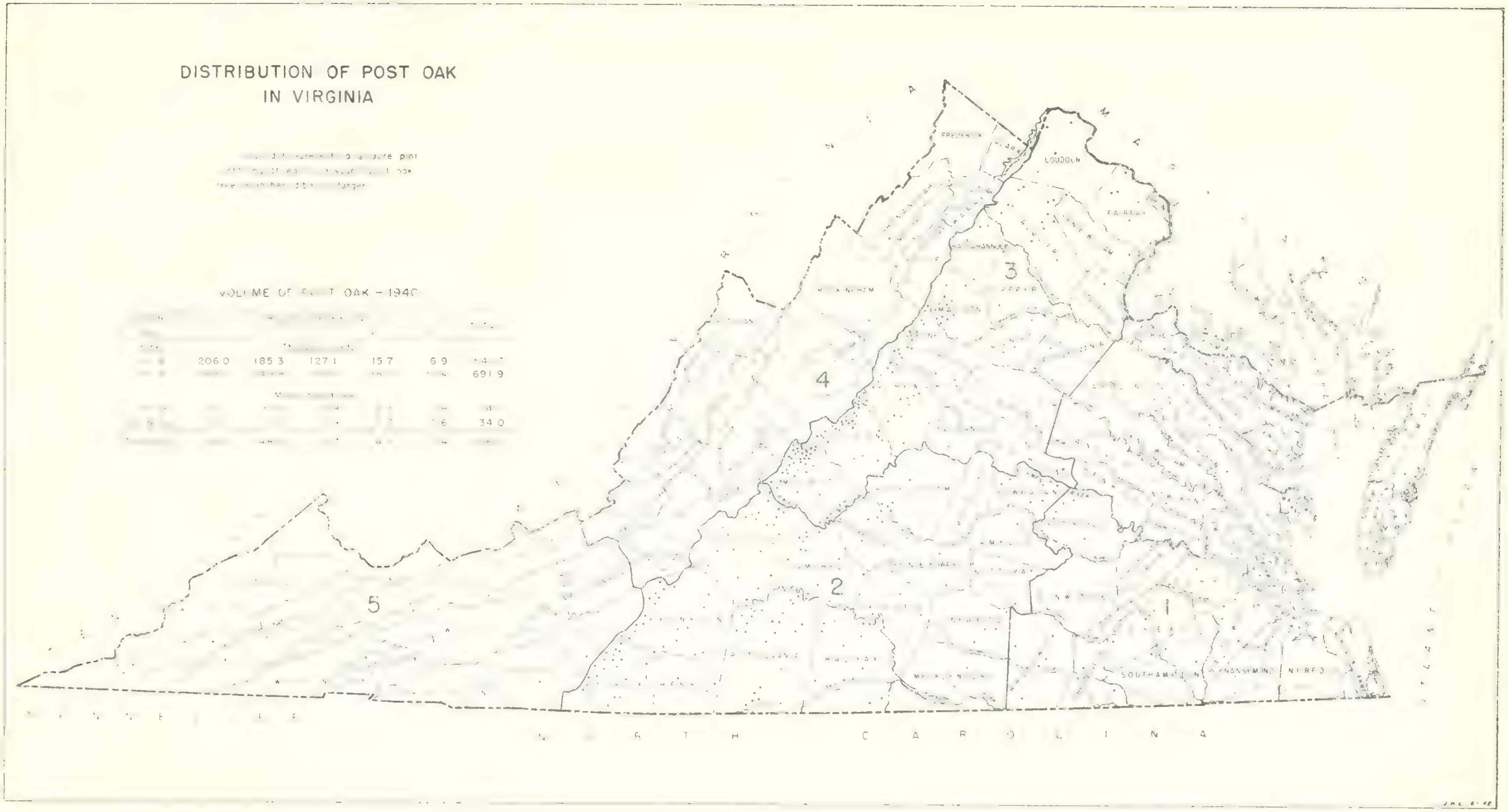
DISTRIBUTION OF NORTHERN RED OAK IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound northern red oak tree 16 inches d.b.h. or larger

VOLUME OF NORTHERN RED OAK – 1940

Diameter class	VIRGINIA SURVEY UNIT					TOTAL
	1	2	3	4	5	
Inches			Thousand cords			
6 – 8	118.5	152.2	161.7	186.8	34.9	754
10 – 12	144.8	172.0	209.7	292.9	252.4	1,071.8
			Million board feet			
14 – 18	48.6	70.2	92.1	111.1	96.6	418.6
20 & over	103.6	125.4	150.0	141.6	124.9	645.5
Total bd. ft.	152.2	195.6	242.1	252.7	221.5	1,064.1

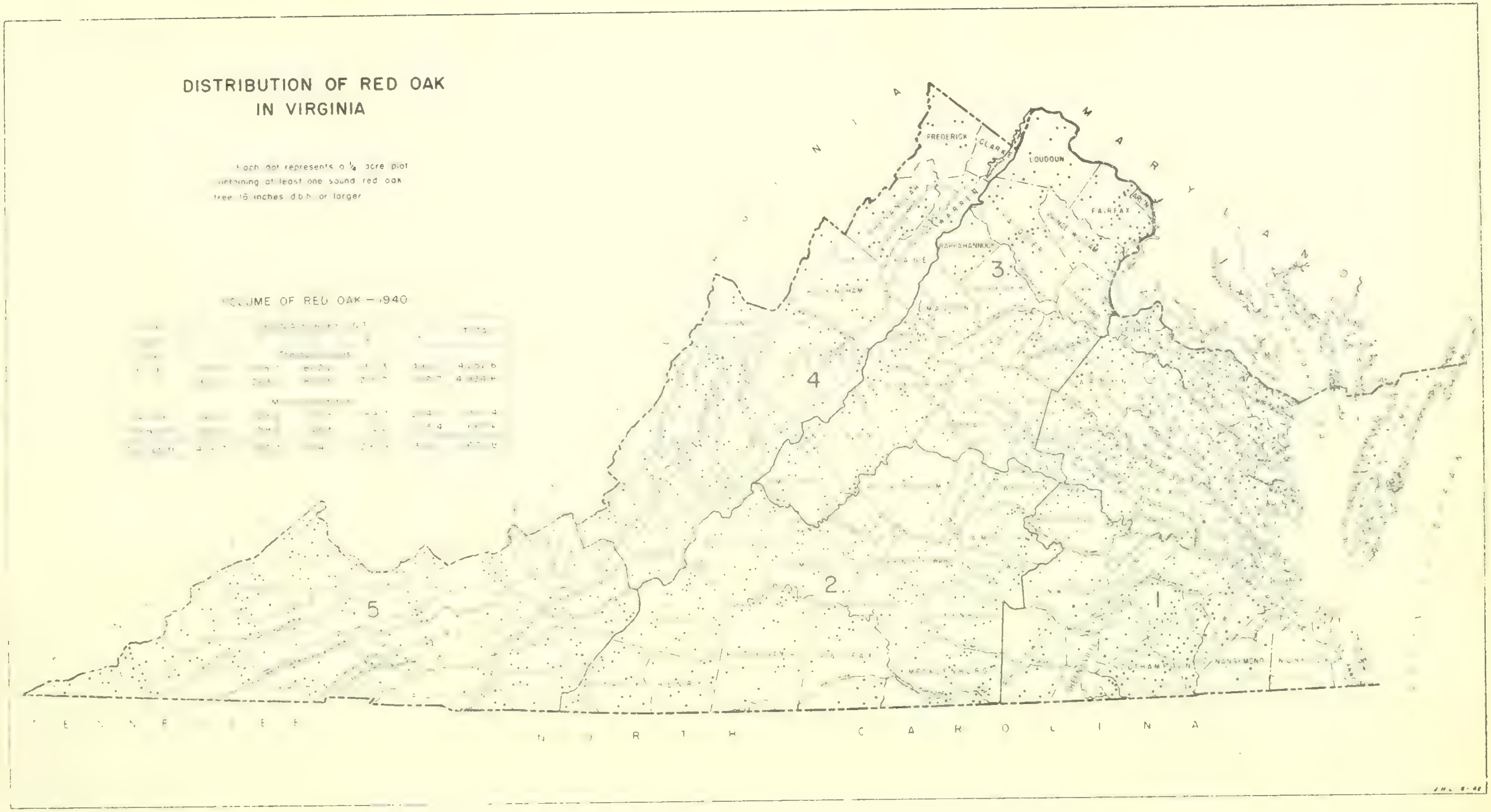
DISTRIBUTION OF POST OAK IN VIRGINIA



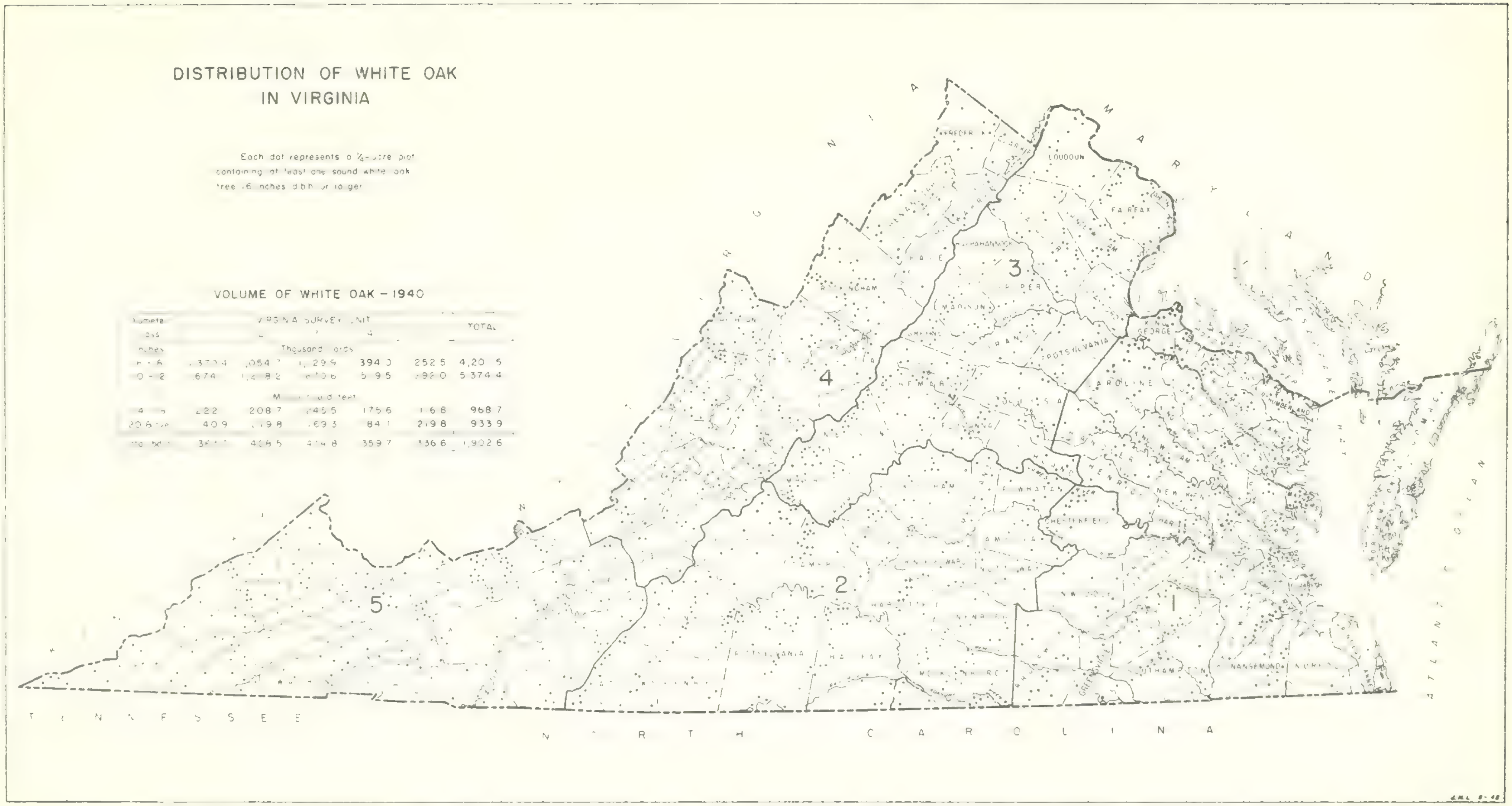
[illegible]

VOLUME OF POST OAK – 1940

[illegible]	206.0	185.3	127.1	15.7	6.9	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	691.9
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6	34.0


DISTRIBUTION OF RED OAK IN VIRGINIA
Each dot represents a ¼ acre plot containing at least one sound red oak tree 16 inches d.b.h. or larger
VOLUME OF RED OAK — 1940
[illegible]
MARYLAND
PENNSYLVANIA
TENNESSEE
NORTH CAROLINA
FREDERICK
CLARKE
LOUDOUN
FAIRFAX
ARL'N
WARREN
RAPPAHANNOCK
PRINCE WILLIAM
FAUQUIER
SOUTHAMPTON
NANSEMOND
NORFOLK
MECKLENBURG
HENRY
1
2
3
4
5
JHL 6-48

DISTRIBUTION OF WHITE OAK IN VIRGINIA



Each dot represents a ¼-acre plot containing at least one sound white oak tree 6 inches d.b.h. or larger

VOLUME OF WHITE OAK – 1940

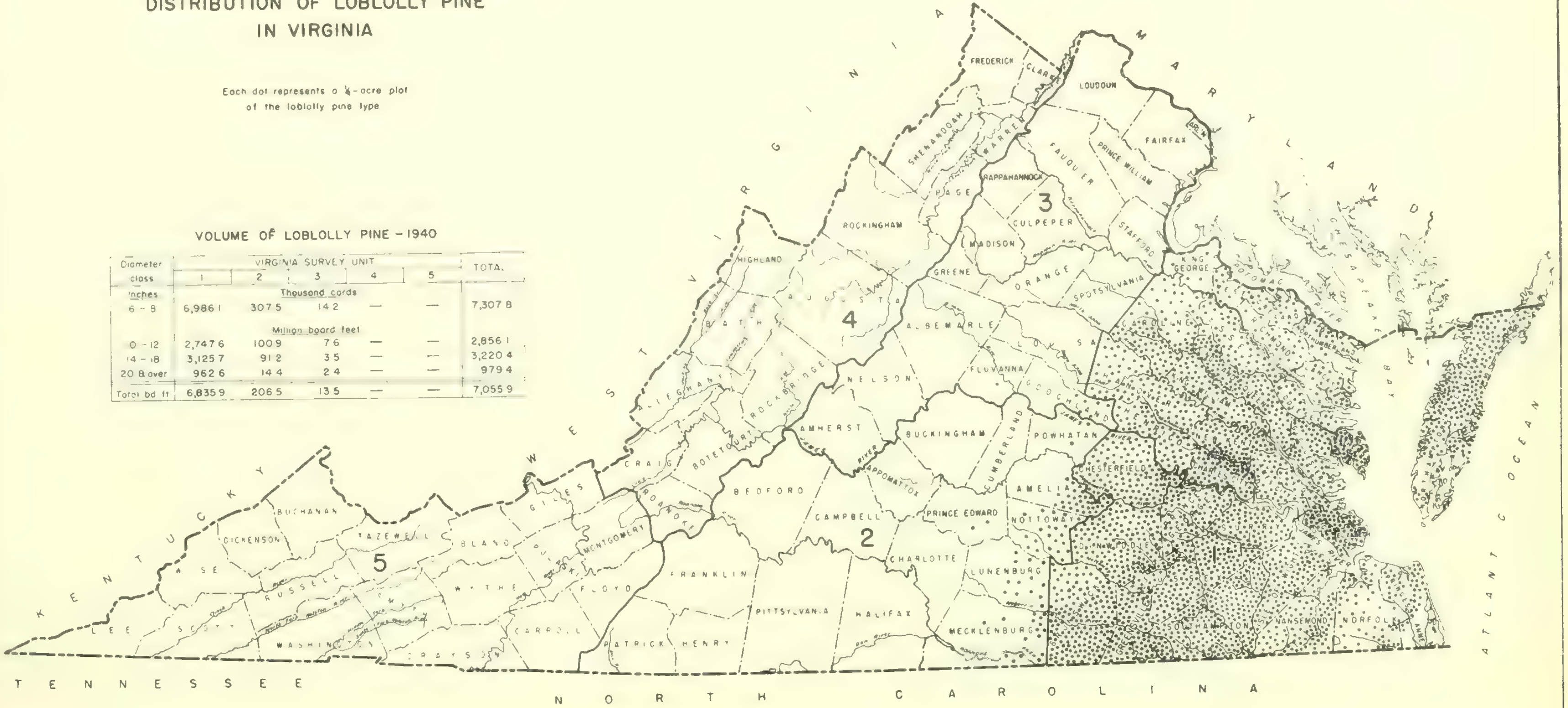
Diameter class	Virginia Survey Unit 1	2	3	4	5	TOTAL
Inches	Thousand cords					
6 - 8	1,372.4	1,054.7	1,129.9	394.0	252.5	4,203.5
10 - 12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5,374.4
	Million board feet					
14 - 18	[illegible]	208.7	245.5	175.6	[illegible]	968.7
20 & over	409	[illegible]	169.3	84.1	219.8	933.9
All classes	[illegible]	[illegible]	414.8	359.7	336.6	1,902.6

DISTRIBUTION OF LOBLOLLY PINE IN VIRGINIA

Each dot represents a ¼-acre plot of the loblolly pine type

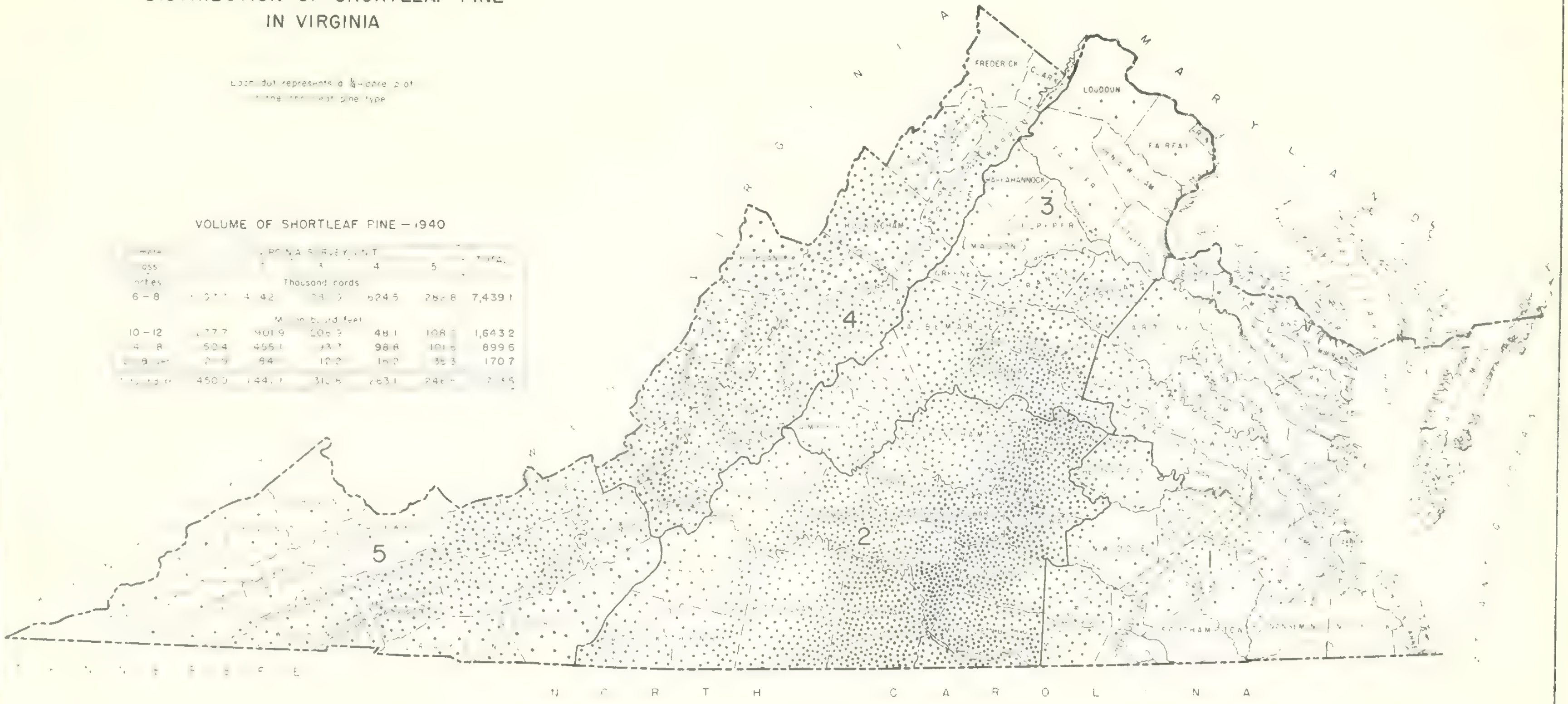
VOLUME OF LOBLOLLY PINE - 1940

Diameter class	VIRGINIA SURVEY UNIT					TOTA.
	1	2	3	4	5	
Inches	Thousand cords					
6 - 8	6,986.1	307.5	14.2	—	—	7,307.8
	Million board feet					
0 - 12	2,747.6	100.9	7.6	—	—	2,856.1
14 - 18	3,125.7	91.2	3.5	—	—	3,220.4
20 & over	962.6	14.4	2.4	—	—	979.4
Total bd ft	6,835.9	206.5	13.5	—	—	7,055.9



DISTRIBUTION OF SHORTLEAF PINE IN VIRGINIA

Each dot represents a ¼-acre plot in the shortleaf pine type

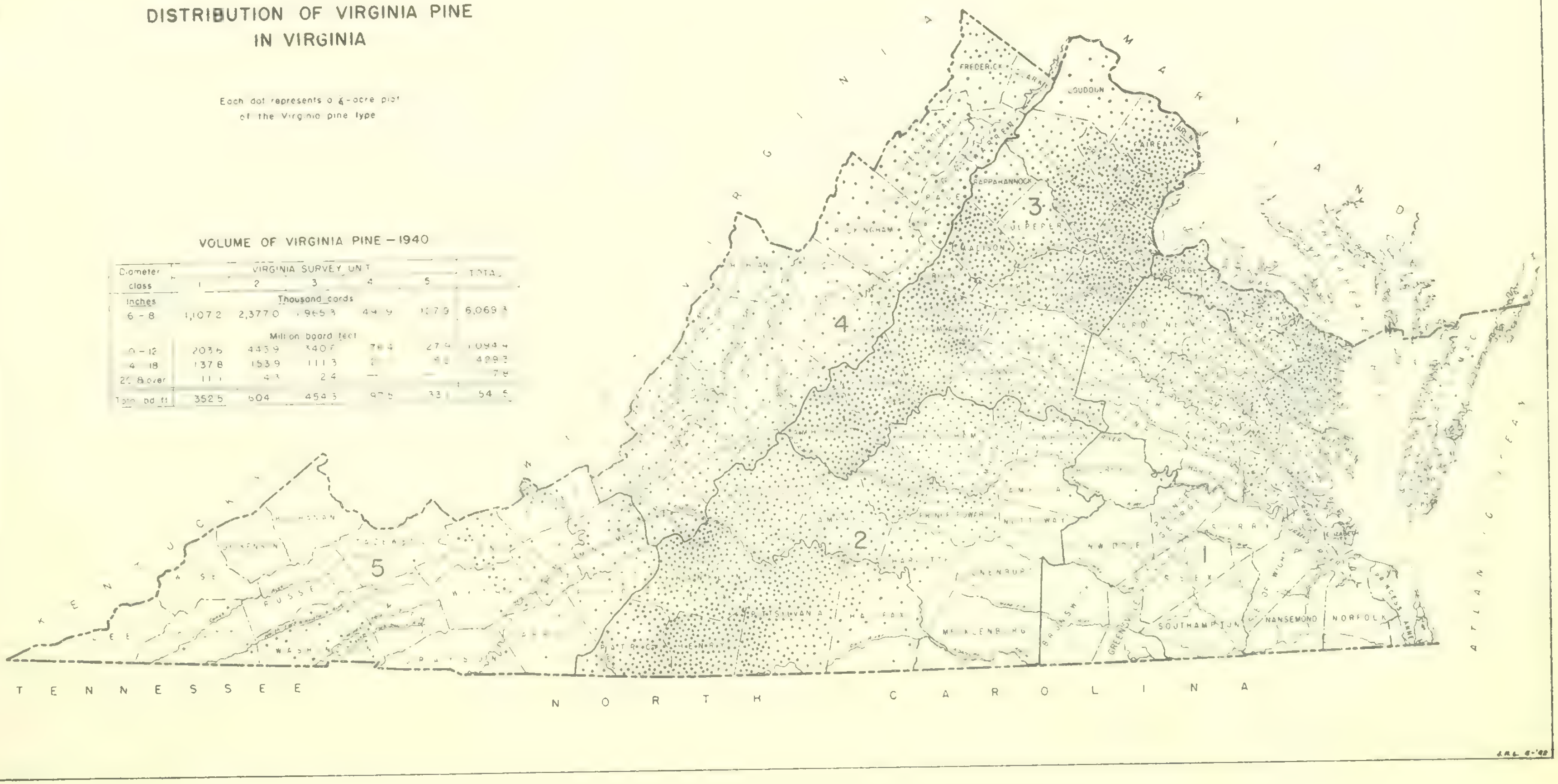


VOLUME OF SHORTLEAF PINE – 1940

Diameter class inches	Virginia survey unit					Total
	[illegible]	[illegible]	3	4	5	
	Thousand cords					
6 – 8	[illegible]	[illegible]	[illegible]	624.5	[illegible]	7,439.1
	Million board feet					
10 – 12	[illegible]	901.9	206.3	48.1	[illegible]	1,643.2
[illegible]	50.4	455.1	[illegible]	98.8	[illegible]	899.6
[illegible]	[illegible]	84	[illegible]	[illegible]	35.3	170.7
[illegible]	450.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

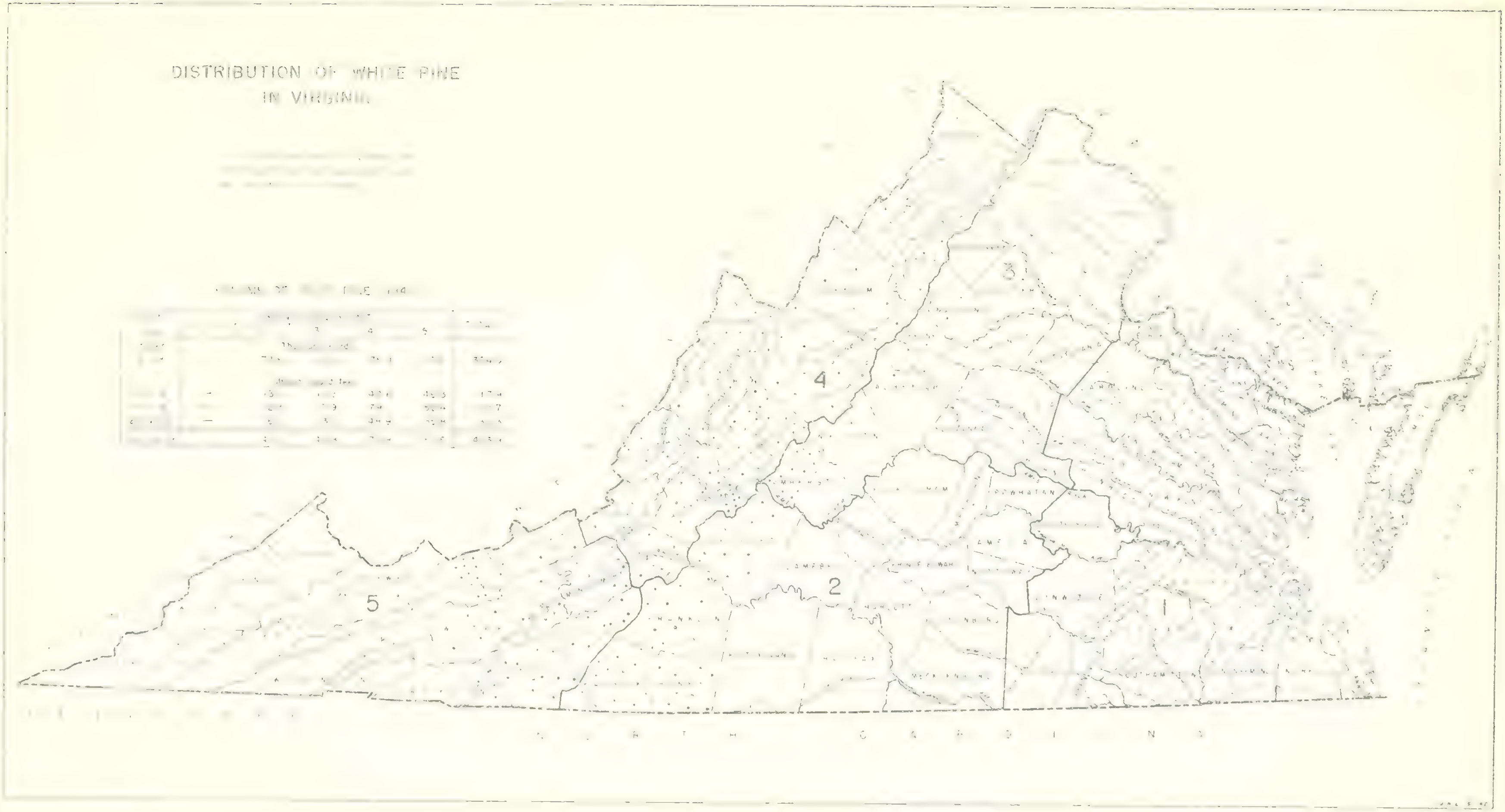
DISTRIBUTION OF VIRGINIA PINE IN VIRGINIA

Each dot represents a ⅛-acre plot of the Virginia pine type

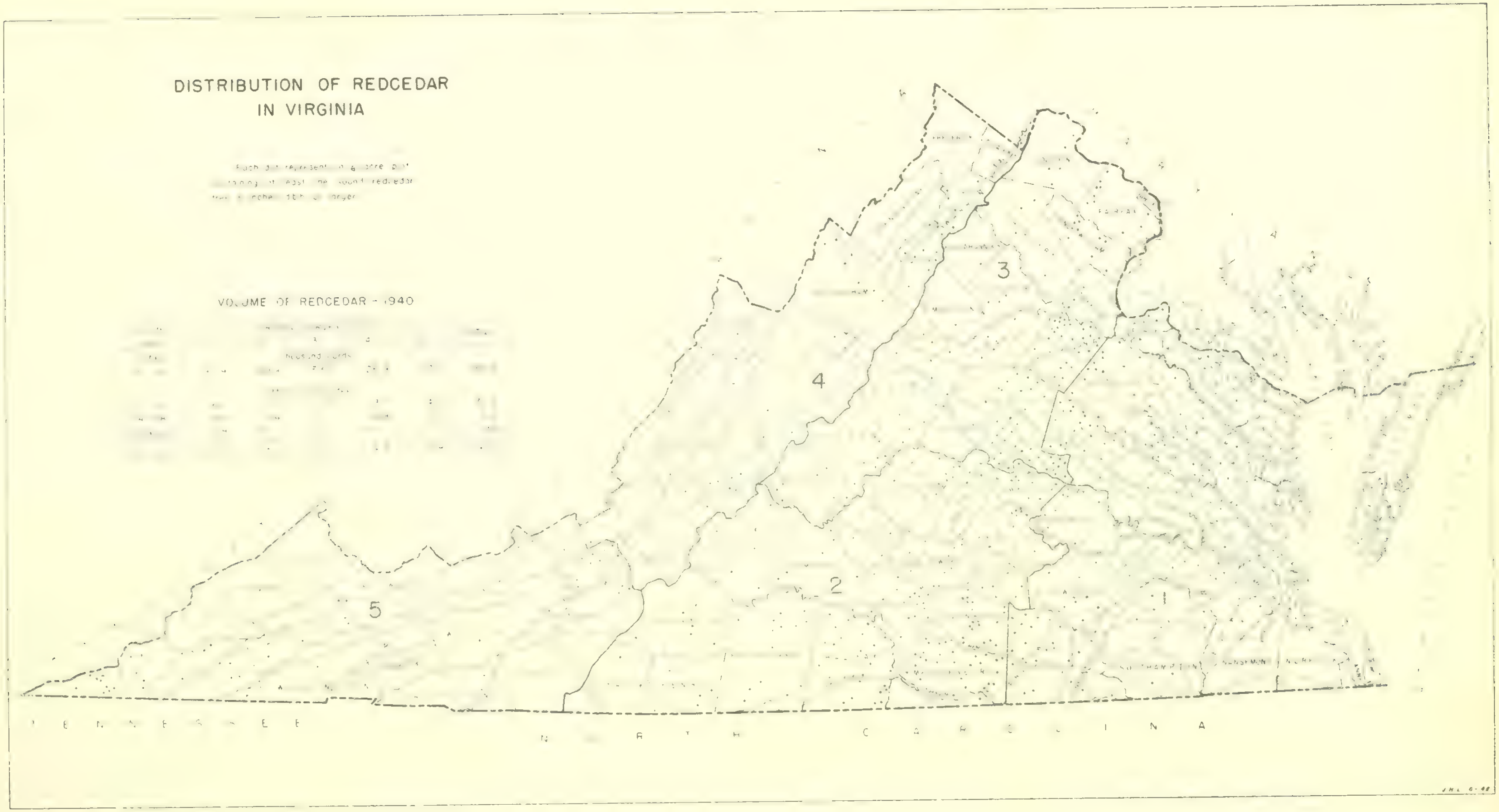


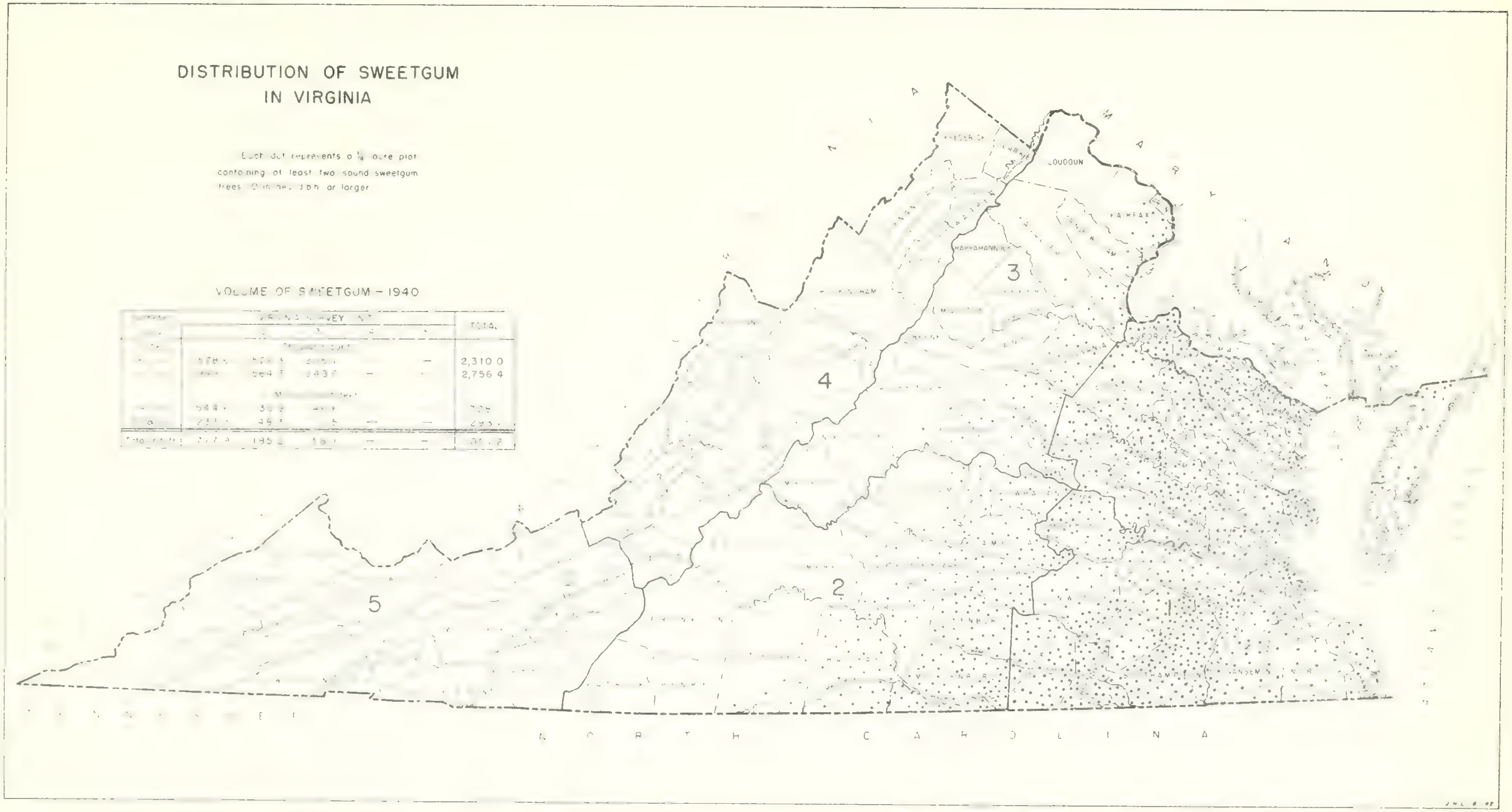
VOLUME OF VIRGINIA PINE — 1940

Diameter class	Virginia Survey Unit 1	2	3	4	5	Total
Inches			Thousand cords			
6 - 8	1,107.2	2,377.0	1,965.3	44[illegible].9	1[illegible]7.9	6,069.3
			Million board feet			
9 - 12	203.6	443.9	340.6	78.4	27.9	1,094.4
14 - 18	137.8	153.9	111.3	[illegible]	[illegible]	429.3
20 & over	11.1	4.3	2.4	—	—	7.8
Total bd ft	352.5	604	454.3	97.5	33.1	54[illegible].5



DISTRIBUTION OF WHITE PINE IN VIRGINIA


DISTRIBUTION OF REDCEDAR
IN VIRGINIA
Each dot represents an 8-acre plot
containing at least one sound redcedar
tree 5 inches d.b.h. or larger
VOLUME OF REDCEDAR - 1940
Thousand cords
1
2
3
4
5
FAIRFAX
SOUTHAMPTON
NANSEMOND
NORFOLK
TENNESSEE
NORTH CAROLINA
JHL 6-48

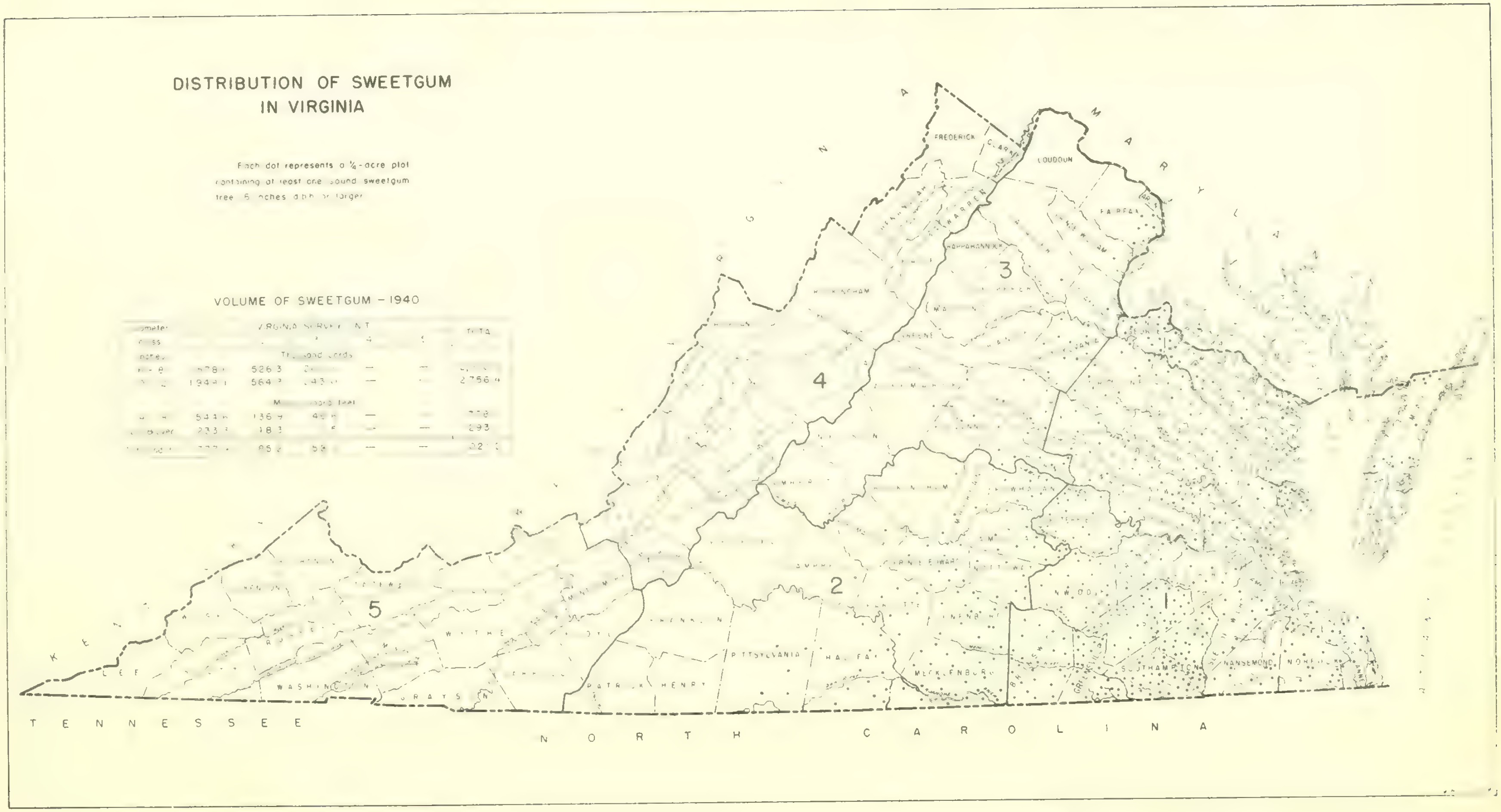


DISTRIBUTION OF SWEETGUM
IN VIRGINIA

Each dot represents a ¼ acre plot containing at least two sound sweetgum trees [illegible] inches d.b.h. or larger

VOLUME OF SWEETGUM – 1940

[illegible]	VIRGINIA SURVEY UNIT					TOTAL
	1	2	3	4	5	
[illegible]	[illegible]					
[illegible]	1,178.[illegible]	52[illegible]	[illegible]		—	2,310.0
[illegible]	[illegible]	564.[illegible]	[illegible]43[illegible]	—	[illegible]	2,756.4
	[illegible]					
[illegible]	544.[illegible]	35[illegible]	[illegible]			[illegible]
[illegible]	23[illegible]	49.[illegible]	5	—	—	[illegible]
Total [illegible]	[illegible]	185.[illegible]	[illegible]	—	—	[illegible].2

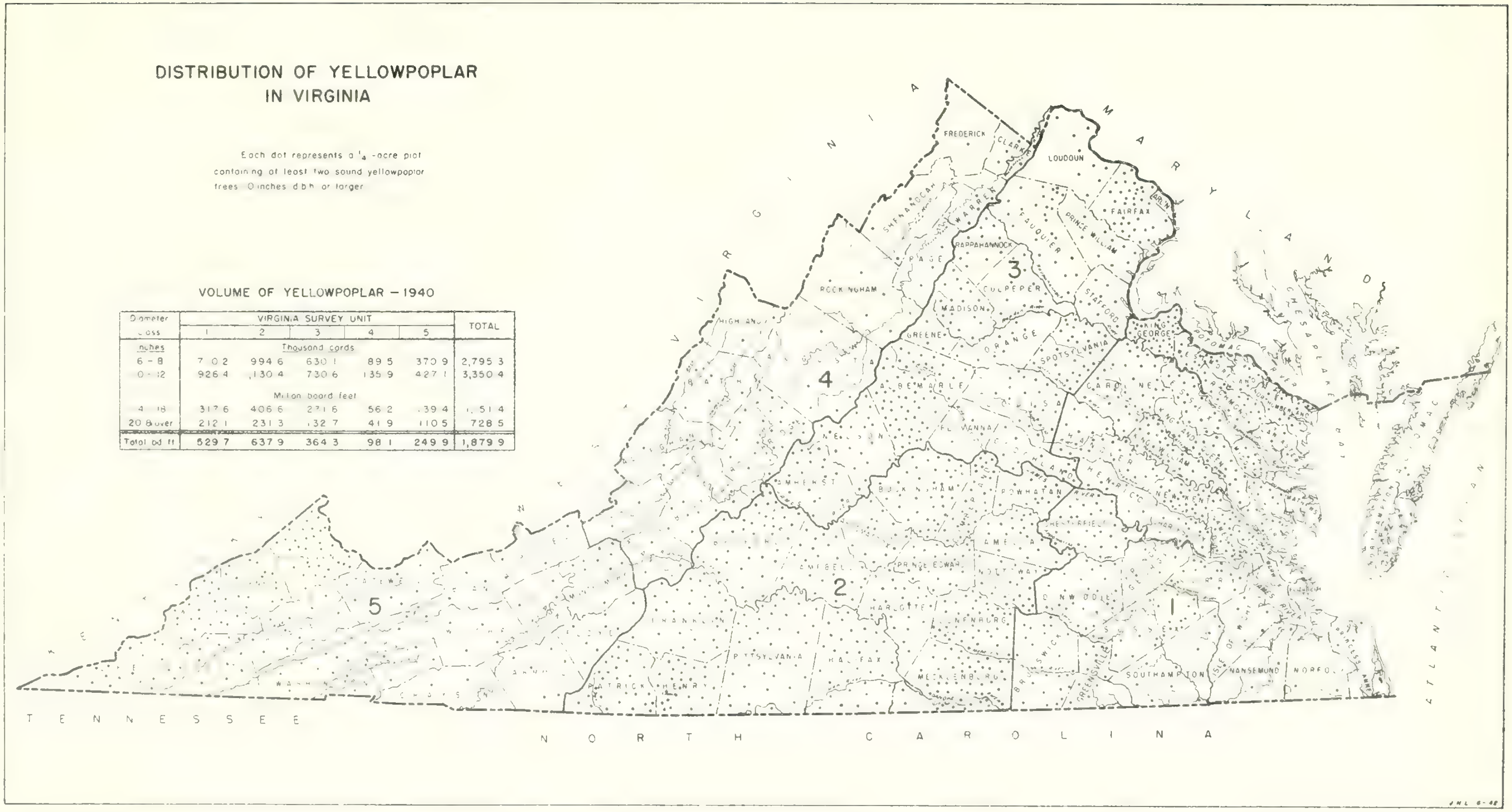


DISTRIBUTION OF SWEETGUM IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound sweetgum tree 5 inches d.b.h. or larger

VOLUME OF SWEETGUM – 1940

Diameter class (inches)	Virginia Survey Unit					Total
	1	2	3	4	5	
	Thousand cords					
[illegible]	[illegible]	526.3	[illegible]	—	—	[illegible]
[illegible]	1944.[illegible]	564.[illegible]	[illegible]43.[illegible]	—	—	2756.4
	Million board feet					
[illegible]	544.[illegible]	136.9	4[illegible]	—	—	[illegible]
[illegible]	233.[illegible]	18.3	[illegible]	—	—	293
[illegible]	[illegible]	85.[illegible]	53.[illegible]	—	—	[illegible]



DISTRIBUTION OF YELLOWPOPLAR IN VIRGINIA

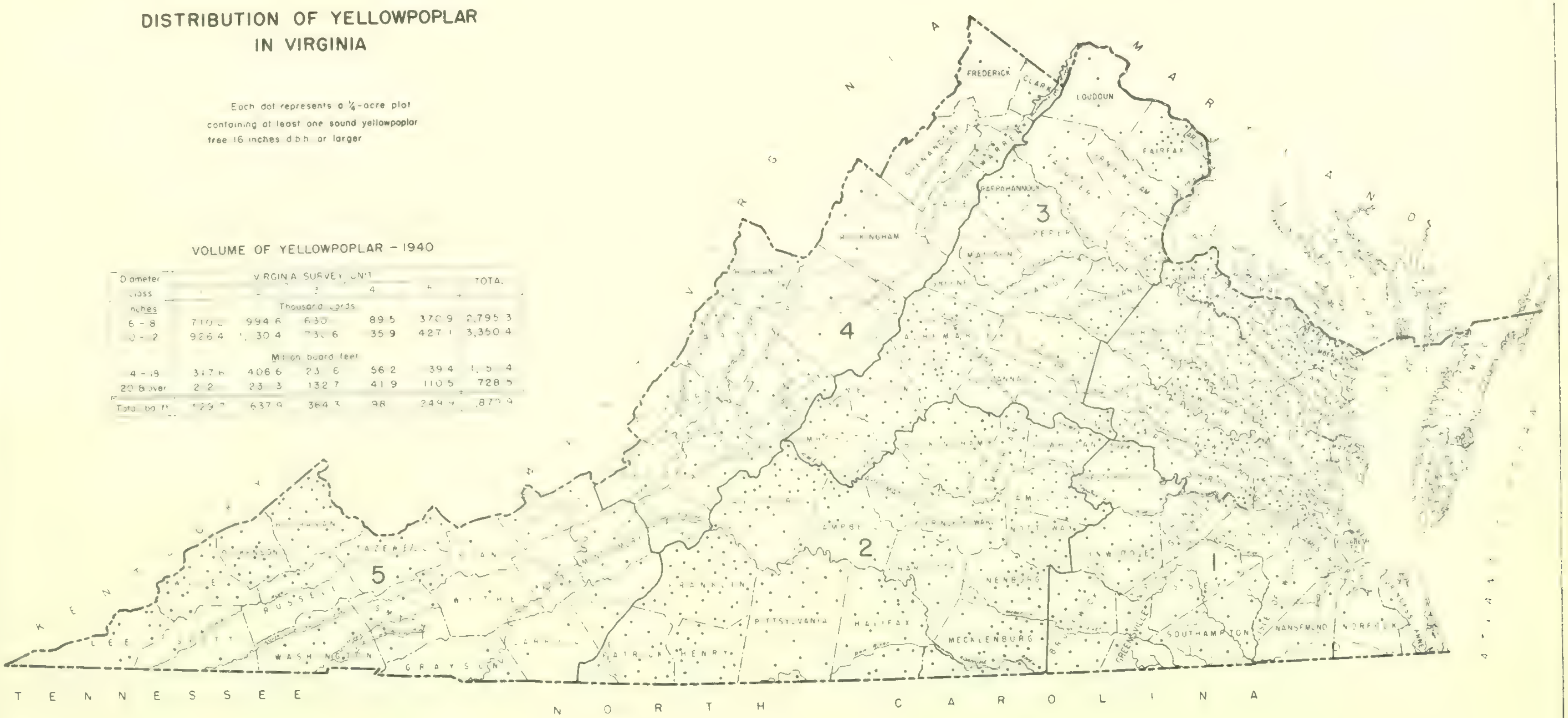
Each dot represents a ¼-acre plot containing at least two sound yellowpoplar trees 10 inches d.b.h. or larger

VOLUME OF YELLOWPOPLAR – 1940

Diameter class	VIRGINIA SURVEY UNIT					TOTAL
	1	2	3	4	5	
Inches	Thousand cords					
6 - 8	710.2	994.6	630.1	89.5	370.9	2,795.3
10 - 12	926.4	1,130.4	730.6	135.9	427.1	3,350.4
	Million board feet					
14 - 18	317.6	406.6	231.6	56.2	139.4	1,151.4
20 & over	212.1	231.3	132.7	41.9	110.5	728.5
Total bd ft	529.7	637.9	364.3	98.1	249.9	1,879.9

DISTRIBUTION OF YELLOWPOPLAR IN VIRGINIA

Each dot represents a ¼-acre plot containing at least one sound yellowpoplar tree 16 inches d.b.h. or larger



VOLUME OF YELLOWPOPLAR – 1940

Diameter class	VIRGINIA SURVEY UNIT					TOTAL
	1	2	3	4	5	
Inches	Thousand cords					
6 - 8	710.[illegible]	994.6	630	89.5	370.9	2,795.3
10 - 12	926.4	1,130.4	[illegible]	35.9	427.1	3,350.4
	Million board feet					
14 - 18	317.6	406.6	[illegible]	56.2	39.4	[illegible]
20 & over	[illegible]	[illegible]	132.7	41.9	110.5	728.5
Total bd. ft.	[illegible]	637.9	364.3	98	249.9	[illegible]

FOREST SURVEY RELEASE NO. 11 NOVEMBER 1, 1942

VIRGINIA'S FORESTS

By

Thomas Lotti, Forest Economist

Thomas C. Evans, Associate Silviculturist

A FOREST SURVEY PROGRESS REPORT

J. W. Cruikshank, Regional Survey Director

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

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Assisting in Preparation of this Report

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John Carow -- Field supervisor of inventory field work

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A FOREST SURVEY PROGRESS REPORT

LIST OF BASIC TABLES

Table No.	Title	State of Virginia	Provinces of the State		
			Coastal Plain	Piedmont	Mountains
		- - - - Appendix Page Number - - - -			
1	Land use	2	18	32	46
2	Forest area by forest types and forest conditions	3	19	33	47
3	Species composition of forest types expressed in percent of net cubic volume	4	20	34	48
4	Net board-foot volume by species and forest conditions	5	21	35	49
5	Net board-foot volume by species and diameter classes	6	22	36	50
6	Net board-foot volume per acre by forest conditions and forest types	7	23	37	51
7	Distribution of saw-timber area and volume by volume-per-acre classes and type groups	8	24	38	52
8	Net cordwood volume by species and sources of material	9	25	39	53
9	Net cordwood volume by species and diameter classes	10	26	40	54
10	Cordwood volume per acre by forest conditions and types	11	27	41	55
11	Net cubic-foot volume of all sound material by species and sources of material	12	28	42	56
12	Volume of wood processed by the primary forest-products industries	13	29	43	57
13	Volume of wood cut from the sound-tree growing stock (commodity drain)	14	30	44	58
14	The effect of growth, mortality, and commodity drain upon the forest growing stock	15	31	45	59
15	Net changes in saw-timber growing stock by species groups and diameter classes	16	16	16	16
16	Net changes in growing stock of all material by species groups and diameter classes	17	17	17	17

PREFACE

This preliminary report has been prepared to make available, in advance of more complete unit and State reports, certain basic data to facilitate the conduct of public and private forest enterprises and to furnish the War Production Board with information on the volume, quality, and availability of critical timber species. The report is a contribution of the Forest Survey organized by the Forest Service to carry out the provisions of the McSweeny-McNary Act of May 1928. This act authorized the Secretary of Agriculture to conduct a comprehensive nation-wide survey of forest resources.

The field work in connection with this report was done in 1940 by the Appalachian Forest Experiment Station, and involved the following major items:

1. Determination of the extent, location, and condition of forest lands, and the quantity and character of the timber on these lands.
2. Determination of the current rate of timber growth.
3. Determination of industrial and domestic wood use, and the total loss from fire, insects, disease, suppression, and from other causes.

Information on the existing forest resources was obtained by means of 31,400 quarter-acre plots established at intervals of one-eighth of a mile on compass lines 10 miles apart, sampling the entire State. The statistical sample obtained from the plot records forms the basis for all area and volume estimates in this report. Data on consumption of forest products for industrial and domestic purposes were obtained in the first half of 1941 by a canvass of all primary manufacturing plants and a number of representative consumers.

The characteristics of Virginia's forests are shown in the accompanying tables for the entire State and separately for the 3 physiographic provinces recognized by the Forest Survey. A large part of the following discussion deals with the forest situation in the State as a whole. For more specific information relative to the physiographic divisions, which differ considerably in forest characteristics, refer to appropriate tables, pages 16 to 59 of the Appendix.

In process of preparation are separate and more complete reports on the Forest Survey findings in the Coastal Plain, Piedmont, and Mountain units or provinces of the State. In addition, a comprehensive report on the forest resources of the entire State eventually will be prepared.

VIRGINIA'S FORESTS

Forest Area and Types

The present commercial forest occupies 14.4 million acres,[1] 56 percent of the total land area (table 1). Seven major forest types are recognized, each representing broad characteristics of forest composition but each made up of minor associations of trees (fig. 1). Most characteristic of the Coastal Plain province are the loblolly and bottomland hardwood types. Shortleaf pine[2] and Virginia pine types are more prevalent on the Piedmont than elsewhere. White pine and the cove hardwood types[3] are confined mostly to the Mountains. The upland hardwood type is found in the Mountains, Piedmont, and to a lesser extent in the Coastal Plain. In the State as a whole hardwood types predominate, occupying 8.2 million acres with softwood types second, occurring on 6.2 million acres (table 2).

Species

The fifty or more commercial tree species found in Virginia have been classified into 5 major species groups; oaks, gums and yellowpoplar, other hardwoods, yellow pines (loblolly, shortleaf, and Virginia), and other softwoods. On the basis of total cubic volume yellow pines, with 36 percent of total, are most prevalent (table 3). Oaks comprise 30 percent of the stand, the gums-yellowpoplar 17 percent, other hardwoods 14 percent, and other softwoods only 3 percent.

Condition

A classification of the forest area according to its condition with respect to size, age, and cutting history of the timber, discloses that 50 percent of the total area is in saw-timber stands, 45 percent is in cordwood, and only 5 percent[4] is reproduction (table 2). Significant are the facts that of the total forest area only 2 percent is in old-growth and the remainder, or 98 percent, is in second-growth.

---

[1] Does not include 235,900 acres of State and Federal forest lands (78 percent in the Shenandoah National Park, 15 percent in numerous Federal monuments, cemeteries, military and similar areas, and 7 percent in various State parks) upon which cutting is prohibited and 184,900 of forest land too poor to produce commercial timber. These areas were not inventoried and are not included except in land use tables in Appendix.

[2] A variation of the shortleaf pine type (shortleaf-pitch pine) is found in the Mountain province. This is shown separately in figure 1 but is combined with the shortleaf pine type elsewhere.

[3] Although the aggregate area of cove hardwoods is large, individual tracts are too small to be shown on the State map.

[4] Clearcut or otherwise denuded forest land amounting to about 0.1 percent (18,600 acres) of the commercial forest area is included with the reproduction condition.

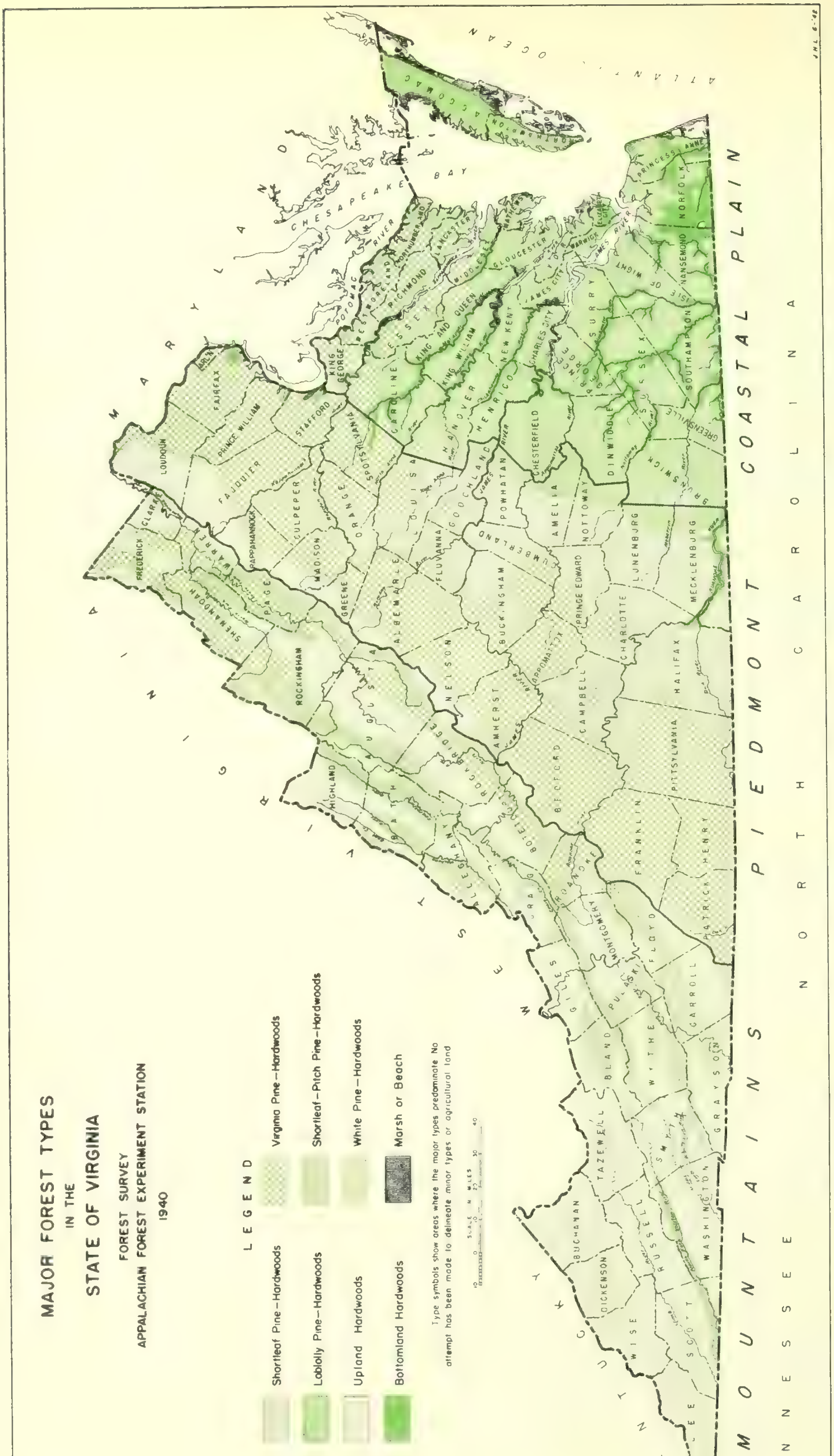
MAJOR FOREST TYPES
IN THE
STATE OF VIRGINIA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1940
LEGEND
Shortleaf Pine–Hardwoods
Loblolly Pine–Hardwoods
Upland Hardwoods
Bottomland Hardwoods
Virginia Pine–Hardwoods
Shortleaf–Pitch Pine–Hardwoods
White Pine–Hardwoods
Marsh or Beach
Type symbols show areas where the major types predominate. No attempt has been made to delineate minor types or agricultural land
SCALE IN MILES
10 0 10 20 30 40
MARYLAND
WEST VIRGINIA
KENTUCKY
TENNESSEE
NORTH CAROLINA
ATLANTIC OCEAN
CHESAPEAKE BAY
POTOMAC RIVER
MOUNTAINS
PIEDMONT
COASTAL PLAIN
ACCOMAC
NORTHAMPTON
PRINCESS ANNE
NORFOLK
NANSEMOND
ISLE OF WIGHT
SOUTHAMPTON
GREENSVILLE
SUSSEX
SURRY
PRINCE GEORGE
DINWIDDIE
BRUNSWICK
MECKLENBURG
LUNENBURG
NOTTOWAY
AMELIA
CHESTERFIELD
CHARLES CITY
JAMES CITY
YORK
WARWICK
ELIZABETH CITY
GLOUCESTER
MATHEWS
MIDDLESEX
LANCASTER
NORTHUMBERLAND
RICHMOND
WESTMORELAND
ESSEX
KING AND QUEEN
KING WILLIAM
NEW KENT
HENRICO
HANOVER
CAROLINE
KING GEORGE
STAFFORD
SPOTSYLVANIA
FAIRFAX
ARLINGTON
PRINCE WILLIAM
LOUDOUN
FAUQUIER
CULPEPER
ORANGE
LOUISA
GOOCHLAND
POWHATAN
CUMBERLAND
FLUVANNA
ALBEMARLE
GREENE
MADISON
RAPPAHANNOCK
CLARKE
FREDERICK
WARREN
SHENANDOAH
PAGE
ROCKINGHAM
AUGUSTA
NELSON
BUCKINGHAM
PRINCE EDWARD
CHARLOTTE
APPOMATTOX
AMHERST
CAMPBELL
HALIFAX
PITTSYLVANIA
BEDFORD
FRANKLIN
HENRY
PATRICK
ROCKBRIDGE
HIGHLAND
BATH
ALLEGHANY
BOTETOURT
CRAIG
ROANOKE
MONTGOMERY
FLOYD
CARROLL
PULASKI
GILES
BLAND
WYTHE
GRAYSON
TAZEWELL
SMYTH
WASHINGTON
RUSSELL
BUCHANAN
DICKENSON
WISE
SCOTT
LEE
JAMES RIVER
YORK RIVER
J.H.L. 6-'42

FIGURE I

Board-Foot Volume

The total net saw-timber volume, excluding 758.4 million board feet of dead chestnut, is estimated at 24.3 billion board feet (Int. $\frac{1}{4}$-inch rule), consisting of hardwoods and softwoods in about equal proportion (table 4). Ninety-two percent of the softwood volume is made up of the yellow pines, and almost one-half of the board-foot volume in hardwoods is oak. Of the total board-foot volume, 94 percent is in saw-timber stands and the remainder in the cordwood areas.

Trees of small diameter contain most of the saw-timber volume. About three-fifths of the hardwood volume is in trees under 20-inches d.b.h. (table 5). Almost one-half of the softwood volume is in trees under 13-inches d.b.h. and over four-fifths is in trees less than 20-inches.

The average saw-timber stand contains about 3,250 board feet per acre (table 6). The heaviest average saw-timber stand per acre (5,470 board feet) is in the loblolly pine type and the lightest (2,440 board feet) in the upland hardwood type -- the former being the most prevalent pine type and the latter being dominant among the hardwood associations. Saw timber on the cordwood areas averages about 150 board feet to the acre, principally in small trees or in the form of holdovers from a previous stand.

Many of the stands are understocked; 47 percent of the total saw-timber area (52 percent of the hardwood and 40 percent of the pine) bears stands of less than 2,000 board feet per acre (table 7). Saw-timber stands averaging 10,000 or more board feet per acre occupy only 4 percent of the saw-timber acreage. However, most of the board-foot volume, 83 percent, is in stands having volumes of 2,000 or more board feet per acre.

Cordwood Volume

The total sound cordwood volume in living trees 5-inches d.b.h. and larger is approximately 194.9 million standard cords (table 8). About 46 percent of this volume is in sound saw-timber trees -- 64.3 million cords in the sawlog sections and 26.0 million cords in the upper stems of softwoods and the upper stems and limbs of hardwoods -- 39 percent is in sound trees below saw-timber size, and 15 percent is contained in cull trees. Not included are 9.6 million cords of dead chestnut.

There are about 104.9 million cords of species commonly used for pulp; about three-fifths are softwoods, chiefly (96 percent) yellow pine. Four-fifths of the hardwood pulping volume is made up of the gums-yellowpoplar species group.

Forest Growth

In 1940, the net growth -- the increase in growing stock after deducting for mortality but not for volume cut -- was 1.6 billion board feet of saw timber, or 7.9 million cords of all sound material. This net growth represents an average of 112 board feet or 0.5 cords per acre -- 6.6 percent and 4.0 percent, respectively, of the growing stock. Approximately 53 percent of the net growth, in saw-timber material only, was contributed by the softwood species. However, 54 percent of the growth of all material, including both saw timber and cordwood, was produced by the hardwoods.

Industrial Use

In 30 years Virginia's lumber production has declined sharply -- strong evidence of a diminished saw-timber supply. The cut of sawlogs reached its peak in 1909 when 2.1 billion board feet were processed, ranking Virginia sixth among lumber-producing states. By 1940 Virginia had dropped to eleventh in state production, turning out 1.1 billion board feet of lumber or about one-half of that in the peak year (table 12).

In 1940, 2,763 sawmills were in operation (fig. 2). Ninety-seven percent of these mills, sawing almost three-fourths of the lumber, were of the small portable type of less than 10 thousand board feet daily capacity. Two percent of the mills, cutting about 11 percent of the lumber, had daily capacities of 10 to 20 thousand board feet, and only one percent of the mills, producing about 16 percent of the lumber, had larger capacities. Two-thirds of these larger mills, as well as most of those of medium size, were located in the Coastal Plain. Of the small portable mills the greatest concentration (44 percent) was in the Piedmont and the next greatest (37 percent) in the Mountains. Although the Coastal Plain contained the lowest number of small mills, a total of 507, they far outnumbered the larger mills.

Large mills are usually associated with areas of more abundant saw timber, larger logs, and more extensive holdings by forest industries, which at least partly explains a greater abundance of these plants in the Coastal Plain than elsewhere. The Coastal Plain contains only one-fourth of the State's forest area, yet one-half of the State's saw-timber volume is located there. Furthermore, about 70 percent of the total softwood saw timber in trees over 14-inches d.b.h. and more than a proportionate share of the larger diameter hardwoods are found within this province. Although only about 13 percent of the forest land is controlled by forest industry, the total area considerably exceeds that of similar ownership in the Piedmont or Mountains. Notwithstanding the presence of some large plants in the Coastal Plain, most of the lumber cut there, as well as in other sections of the State, is by portable sawmills; demonstrating that small timber holdings, small-scale logging, small mills, and part-time operation and employment characterize Virginia's lumber industry.

In 1940, more wood was consumed by non-lumber plants and for poles, piling, hewn crossties, mine timbers, fuel wood, and fence posts than for lumber (table 12). One hundred and fifty-six plants, in addition to the sawmills, were using wood as a primary source of raw material (fig. 3). Among the largest of these were the 9 pulp mills, 4 of which were located in the Coastal Plain, 3 in the Mountains, and 2 in the Piedmont. The most numerous plants, excluding sawmills, were 69 cooperage mills, largely

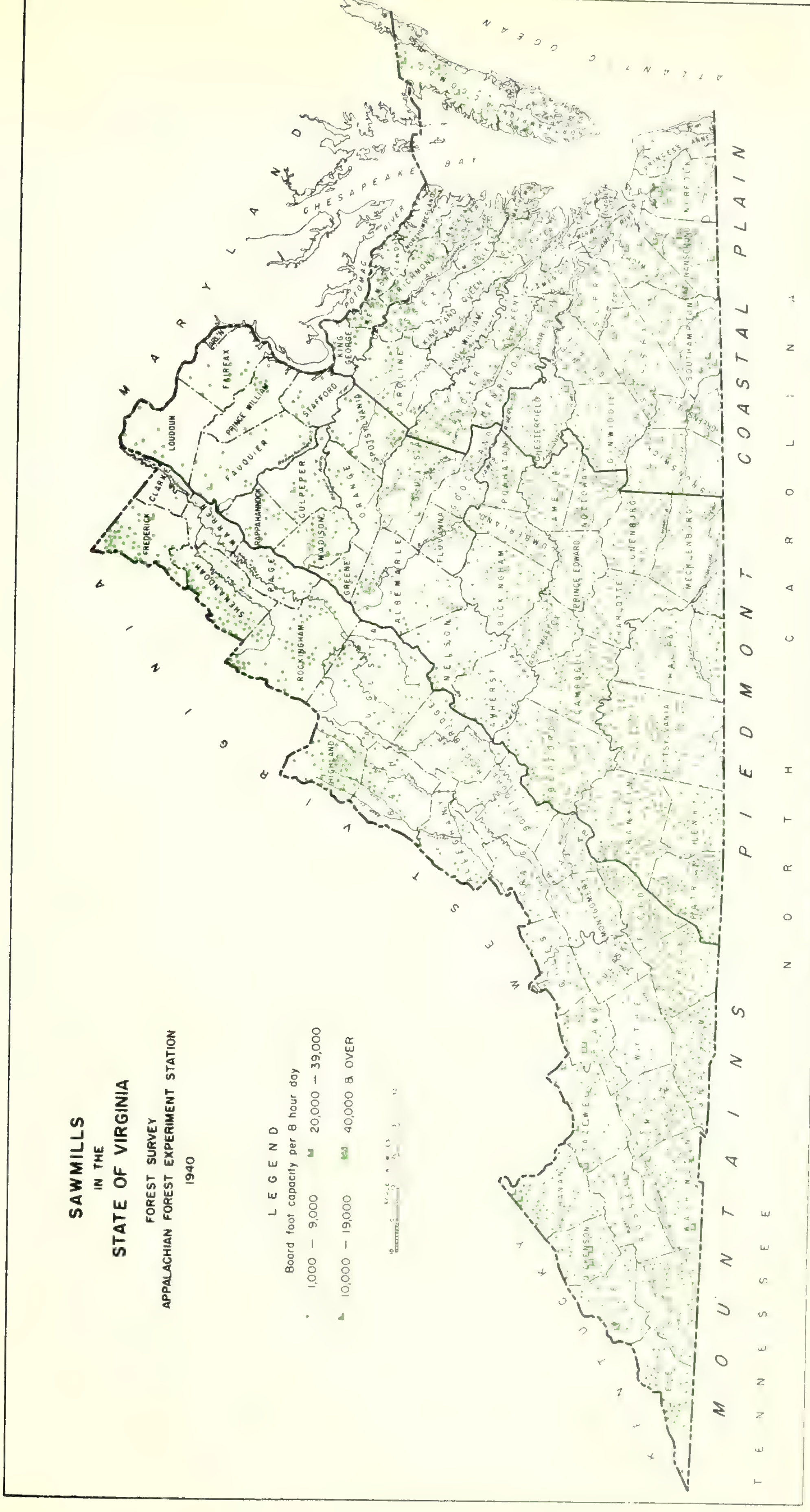
SAWMILLS
IN THE
STATE OF VIRGINIA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1940
LEGEND
Board foot capacity per 8 hour day
1,000 — 9,000
10,000 — 19,000
20,000 — 39,000
40,000 & OVER
MARYLAND
WEST VIRGINIA
KENTUCKY
TENNESSEE
NORTH CAROLINA
ATLANTIC OCEAN
CHESAPEAKE BAY
POTOMAC RIVER
JAMES RIVER
MOUNTAINS
PIEDMONT
COASTAL PLAIN
FREDERICK
CLARKE
LOUDOUN
FAIRFAX
ARLINGTON
PRINCE WILLIAM
FAUQUIER
STAFFORD
KING GEORGE
WARREN
SHENANDOAH
RAPPAHANNOCK
CULPEPER
SPOTSYLVANIA
CAROLINE
PAGE
MADISON
ORANGE
GREENE
ROCKINGHAM
ALBEMARLE
FLUVANNA
HIGHLAND
NELSON
AMHERST
CHESTERFIELD
POWHATAN
CUMBERLAND
BUCKINGHAM
PRINCE EDWARD
NOTTOWAY
DINWIDDIE
CAMPBELL
CHARLOTTE
LUNENBURG
MECKLENBURG
BEDFORD
FRANKLIN
PITTSYLVANIA
HALIFAX
HENRY
PATRICK
MONTGOMERY
TAZEWELL
RUSSELL
WASHINGTON
WYTHE
SMYTH
STEVENSON
BUCHANAN
LEE
SCOTT
CRAIG
BOTETOURT
ALLEGHANY
BATH
AUGUSTA
ROCKBRIDGE
HANOVER
HENRICO
GOOCHLAND
LOUISA
KING WILLIAM
KING AND QUEEN
NEW KENT
CHARLES CITY
ESSEX
RICHMOND
NORTHUMBERLAND
WESTMORELAND
LANCASTER
MIDDLESEX
GLOUCESTER
SURRY
SUSSEX
SOUTHAMPTON
GREENSVILLE
BRUNSWICK
NANSEMOND
NORFOLK
PRINCESS ANNE
ACCOMACK
NORTHAMPTON
AMELIA
JAMES CITY
ISLE OF WIGHT

FIGURE 2

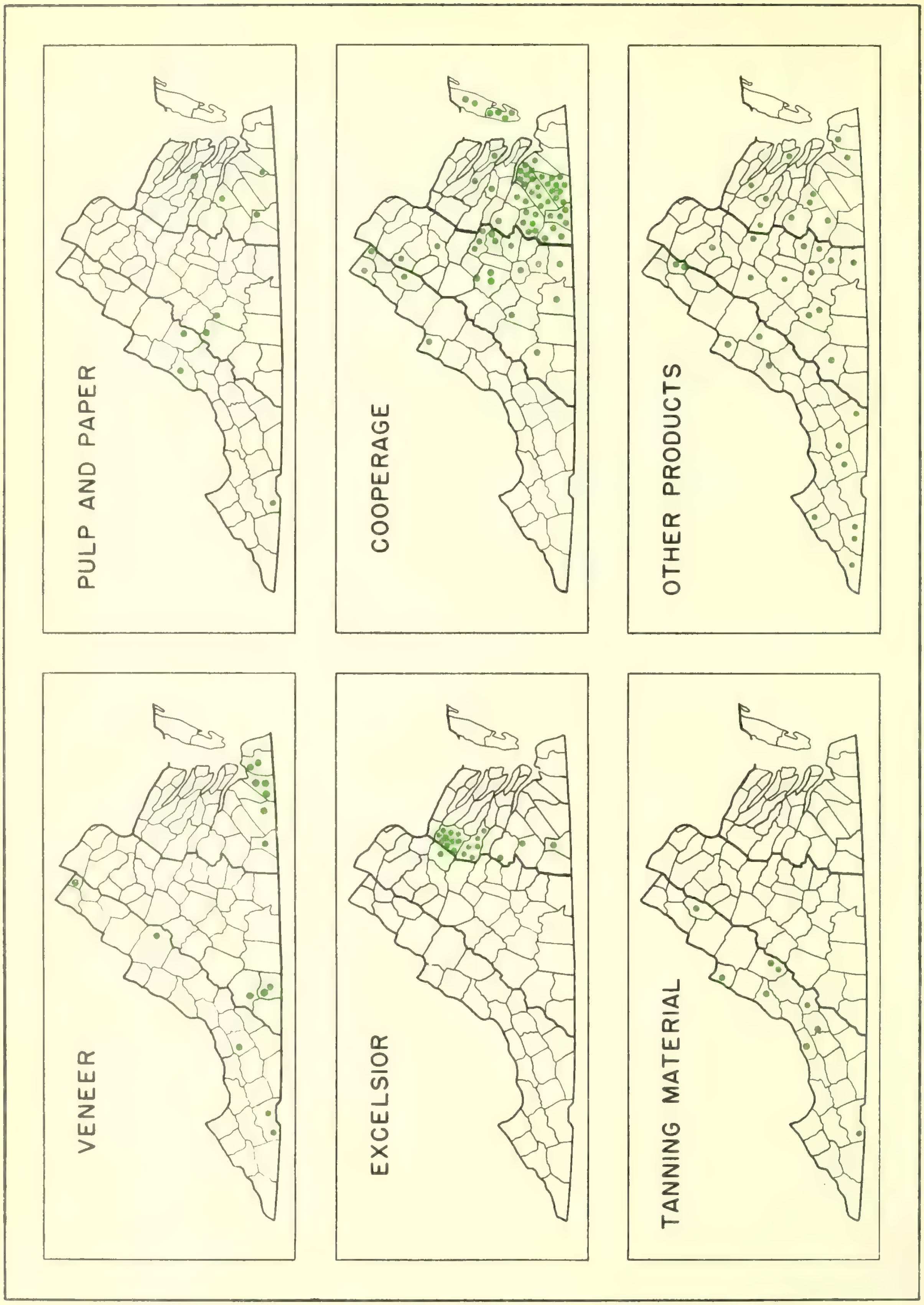

FIGURE 3 — OTHER PRIMARY FOREST PRODUCTS PLANTS IN VIRGINIA, 1940.

engaged in making nail keg staves. Other plants made excelsior, tanning extract, veneer, or miscellaneous products including handles, insulator pins, shingles, and boxes. Altogether, about 1.2 million cords of wood were used in these plants and 4.3 million cords were used for fuel wood, mine timbers, and other rough products. This was about 2.5 million cords more than the volume of sawlogs used by the lumber industry.[1]

Commodity Drain

The total amount of wood cut (commodity drain) in 1940 for all uses, including that shipped outside the State, was 1.3 billion board feet of saw timber or 5.1 million cords[2] of all sound material (table 13). This drain includes both the utilized and wasted portions of the trees cut.

In Board Feet

Approximately two-thirds of the drain, in saw-timber material only, consisted of softwood species, chiefly (95 percent) yellow pines. Slightly over one-half of the hardwood saw-timber drain was oak. About three-fourths of the drain in softwood saw timber and a shade over one-half of that in hardwood was taken from trees under 20-inches d.b.h.

In Cords

Of the drain of all sound material, 5-inches d.b.h. and larger, 2.7 million cords (53 percent) was taken in the form of sawlogs for the production of lumber, timbers, and ties. Next in importance was fuel wood, which amounted to 1.1 million cords, or 22 percent of the total drain. About 0.7 million cords went into pulpwood and the remainder, 0.6 million cords, went to other uses principally cooperage, mine timbers, and fence posts.

By Provinces

Eighty-two percent of the total commodity drain, in equal proportions, was in the Coastal Plain and Piedmont provinces and only 18 percent in the Mountains. The large drain in the Coastal Plain and Piedmont reflects, at least in part, a greater concentration of forest industries, a more productive forest, and a larger proportion of commercially desirable species (loblolly and shortleaf pines) in these provinces than in the Mountains.

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[1] Wood volumes quoted above include wood brought in from outside the State as well as that cut in the State.

[2] Drain expressed in cords, in addition to sawlog portions of trees cut, includes the usable volumes in the upper stems of softwood saw timber and in small trees 5.0 inches d.b.h. to saw-timber size.

By Species-Groups

Fifty-eight percent of the total drain for all commodities consisted of yellow pine, chiefly loblolly and shortleaf. Most of the yellow pine was cut in the Coastal Plain and Piedmont, where this species-group constituted 75 and 61 percent, respectively, of the total drain. Only in the Mountains was the drain predominantly in hardwoods -- comprising, in that province, about 79 percent of the total. For the State as a whole, however, only 37 percent of the total drain was in hardwoods -- principally oaks.

By Diameter Classes

An analysis of total commodity drain by tree diameter classes shows that 66 percent of the 1940 cut was in trees 10- to 20-inches d.b.h., and that about one-half of this amount was in small trees, 10- and 12-inches. About 16 percent of all drain was in trees under 10-inches and approximately 18 percent was in the large trees, 20-inches and over. The distribution of the total drain in cubic feet by diameter class in each physiographic province was as follows:

Diameter class	Coastal Plain	Piedmont	Mountain
Inches	Percent	Percent	Percent
6-8	11	18	18
10-18	67	71	55
20 and over	22	11	27
All diameters	100	100	100

Future Timber Supplies

Any forecast of the future timber supply for large areas is a difficult undertaking, because of the many factors which affect the growth and development of the forest. Among the principal elements involved are normal commodity drain, excessive drain such as that brought about by war demands, the growth rates of individual trees and stands, mortality, cutting practices, and stand composition. Variations in any one of these items may be sufficient to upset even the most carefully computed predictions. Nevertheless, a forecast even though more qualitative than quantitative may be helpful to forest industries, public forestry organizations, and other public and private agencies vitally interested in the future supply of timber.

A comparison between the net growth and drain in 1940 shows a net increase of 1.3 percent in the saw-timber growing stock and 1.8 percent in the total volume in sound trees 5-inches d.b.h. and larger (table 14). Assuming that all growth was on trees that eventually will be cut, the over-all picture as to the future timber supply appears favorable. But, within certain species and diameter groups the situation is not as good as that indicated by a growth surplus for the State and continued cutting at a rate equal to or greater than 1940 may create serious problems for the industries and localities concerned. A case in point is found in the Coastal Plain where the total drain upon the cedar and cypress was 3 times the net increment, and the total growing stock was being reduced in all diameter classes. Continued heavy cutting, as in 1940, 1941, and 1942 probably will result in the virtual elimination of white-cedar saw timber by 1950. Furthermore, there was an inadequate amount of young-growth to assure a significant quantity of white-cedar sawlogs at any time in the future. The cypress may last longer but, at the present rate of cutting, it is a disappearing species in Virginia.

Of greater economic importance than white-cedar and cypress are the oaks, gums and yellowpoplar, and the yellow pine (shortleaf, loblolly, and Virginia) species groups. Nearly sixty percent of the wood cut in 1940 consisted of the yellow pines and about four-fifths of that cut from this species-group was from loblolly and shortleaf. In the same year, 23 percent of all the wood harvested was oak and 10 percent gums and yellow-poplar. It is quite obvious that present-day primary wood-using industries are organized largely for processing one or the other of the above species groups. Hence, a forecast as to the probable future supply of these groups is most important.

The Supply of Oak

Assuming a rate of cutting equal to that of 1940 and also that the cut is distributed to all species, the possibilities for a sustained yield of oak are encouraging, although much of the oak is second-growth and a significant proportion is made up of lower quality species.[1] Thus, trees of high quality, suitable for speciel uses such as ship timbers, are becoming increasingly hard to find. Over the State, the 1940 surplus of growth over drain involved all diameters 5-inches d.b.h. and larger (tables 15 and 16). As a result, the saw-timber growing stock increased 1.8 percent and the total stand gained 1.7 percent in cubic volume. Trees 20-inches and over d.b.h. in the Mountain province were being overcut at a rate which, if continued, would soon eliminate most of the larger oaks in that section. However, a large area (1.3 million acres) in the Mountains is in national forest where cutting practices are so modified that a permanent supply of large oaks -- although probably inadequate to meet all industrial requirements -- should be available. In all provinces a supply of oak under 20-inches d.b.h., equal to or greater than that of the present, can be maintained providing the rate of cutting does not exceed that of 1940. This is also true of larger diameter oaks in the Coastal Plain and Piedmont where growth surpluses also existed in trees 20-inches and over.

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[1] The percent distribution of the oaks based on cubic volume in trees 5.0 inches d.b.h. and over is: white oak 34, chestnut oak 19, northern red oak 12, other red oaks 32, and other white oaks 3.

The Supply of Gums and Yellowpoplar

Except in the 10- and 12-inch diameter class in the Mountains, the 1940 net growth of gums and yellowpoplar exceeded drain in all diameters and in every province. As a result of the surplus growth the saw timber and total growing stock increased by 3.7 and 3.2 percent, respectively. Hence, it is indicated that the gums and yellowpoplar, as a species group, will continue to increase in volume at a fairly rapid rate providing the cut is maintained around the 1940 level. The chief danger is that the commercial preference for sweetgum and yellowpoplar -- both critical species for war use -- will cause serious shortages of these more desirable species in many localities.

The Supply of Virginia Pine

From the facts on hand it appears that the total quantity of Virginia pine will continue to increase, unless the drain materially exceeds the 1940 level. Board-foot growing stock showed a net gain of 3.2 percent during the year, and the total stand, 5-inches d.b.h. and larger, an addition of 4.0 percent. In other words, the rate of increase of the total Virginia pine growing stock was greater than that of any other major species-group in the State. Overcutting occurred among small saw-timber trees of the Coastal Plain, in those of medium size in the Mountains, and in large saw-timber of the Piedmont. But, the growth surpluses in trees of other diameters were sufficient to effect a net gain in the total growing stock in each province.

The favorable situation as to Virginia pine can be attributed to at least 2 factors: (1) the species reproduces aggressively, thus enabling the tree to invade abandoned fields and to establish itself quickly in burned-over areas; (2) it is typically a rather short, crooked, and limby tree, and because of these characteristics, industry prefers shortleaf and loblolly rather than Virginia pine for such uses as lumber and pulpwood. Yet, even now, Virginia pine accounts for about one-fifth of the volume of yellow pine cut for pulpwood; and, because of the existent large area and volume, it is believed that the industrial use of the species will increase.

The Supply of Shortleaf and Loblolly Pines

The future supply of shortleaf and loblolly pines is not as promising as that of the oaks and Virginia pine. In 1940 the saw-timber growing stock was reduced by 0.5 percent although the total stand increased by about 0.1 percent. The decrease in the saw-timber stand was caused by excessive cutting of trees 10- and 12-inches d.b.h. and 20-inches and over. The small increase in total cubic volume resulted from surpluses in 6- and 8-inch and 14- and 18-inch trees. It is apparent that for the State as a whole the margin of safety is extremely small. Any significant increase in commodity drain such as has been brought about by present war demands -- if maintained over a period of years -- most likely will cause a serious loss in growing stock. This is especially true in certain sections of the State where, even in 1940, overcutting was quite heavy.

A clearer insight as to the future supply of loblolly and shortleaf pine may be had by analyzing the situation in the Coastal Plain and Piedmont where 94 percent of the net sound volume in trees 5-inches d.b.h. and larger of these species is found. In making this analysis the following assumptions must hold: (1) that volume recruiting into the 6- and 8-inch diameter class is maintained at the 1940 level, (2) the ratio of inventory to volume recruiting out of any diameter class is the same as in 1940, (3) the growth of trees in any diameter class is similar to that of 1940, and (4) the proportionate distribution of drain by diameter classes remains the same as in 1940.

The total growing stock of shortleaf and loblolly pine -- 92 percent of which is shortleaf pine -- in the Piedmont was reduced 1.2 percent by the commodity drain of 1940. If excessive cutting such as this is continued, all trees above 13-inches d.b.h., for all practical purposes, will be gone within 30 years (table I) in spite of recruitment from smaller diameters. Surviving at that time, would be small saw-timber trees, 10- and 12-inches, and cordwood trees of 6- and 8-inches -- primarily a pulpwood stand. An increased drain, such as has occurred since 1940, has already added momentum to the rate of growing stock depletion. A satisfactory saw-timber stand might again be developed, but with the growing stock in such a condition a considerable lapse of time would be necessary. Furthermore, during the period of restoration it would be absolutely necessary that drain be maintained below growth -- a status that might be difficult to achieve with a depleted growing stock. Hence, for the sake of future lumber production there is an obvious need for reducing the annual drain below that of 1940, particularly in the southern part of the Piedmont where conditions are most acute.

Table I. - Possible changes in volume and distribution of the shortleaf and loblolly pine growing stock in the Virginia Piedmont at two levels of commodity drain over a 30-year period

Diameter class	Growing stock 1940	Growing stock change 1940 to 1970	
		Drain at 1940 level	Drain at 15 percent below 1940 level
Inches	Million cu. ft.	Percent	Percent
6-8	282	+50	+63
10-12	283	-14	+37
14-16	113	-100	+16
20 and over	18	-100	-100
Total	696	-4	+41

As shown in table I, the Piedmont situation could be improved somewhat if annual drain were maintained at about 15 percent below the 1940 level -- a modification that probably would not seriously upset a forest economy similar to that of 1940. With this small reduction in annual cut, an increase of about 282.2 million cubic feet (41 percent) in total growing stock could be effected in about 30 years. Volume increases would occur in all but the large saw-timber trees, 20-inches d.b.h. and larger, and the loss in that diameter class would be more than offset by the gain in other sizes. In truth, the stand would be far from ideal, but certainly a much better one than would result from a continuation of the 1940 drain. The loss of the large saw-timber trees, although undesirable, probably would not create much of a hardship as present-day industry is adapted to the processing of small logs, and even now only 9 percent of the total growing stock consists of trees 20-inches and larger. More important is the fact that the growing stock in the remaining diameter classes would more than hold its own, and with continued judicious cutting will be able to provide a sustained timber supply sufficient to meet most industrial requirements comparable to the 1940 demand.

In the Coastal Plain, where 91 percent of the loblolly-shortleaf growing stock is loblolly pine, the outlook as to a future supply of these species is better than that of the Piedmont. Although trees 10- and 12-inches and 20-inches and larger were overcut in 1940, the growth surpluses in other sizes were sufficient to create a net increase in the total stand of 0.7 percent. Assuming a continued annual cut of the same quantity as in 1940, there will be an appreciable build-up in both quality and volume over a 30-year period (table II). At that rate of cutting, the growing stock can be expected to increase from 2.0 billion cubic feet in 1940 to 3.5 billion cubic feet in 1970, a net gain of 73 percent. The 20-inch and larger class would decrease until about 1945 but then the influx of volume from trees of smaller diameters will begin to take effect and the 20-inch class will gradually increase. Actually the volume distribution by diameter classes would be a decided improvement over the 1940 stand.

Table II. - Possible changes in volume and distribution of the loblolly and shortleaf pine growing stock in the Virginia Coastal Plain at two levels of commodity drain over a 30-year period

Diameter class	Growing stock 1940	Growing stock change 1940 to 1970	
		Drain at 1940 level	Drain at 25 percent above 1940 level
Inches	Million cu. ft.	Percent	Percent
6-8	527	+ 45	+ 28
10-12	735	+ 42	-2
14-18	620	+122	+12
20 and over	165	+115	-100
Total	2,047	+ 73	+ 2

Effect of War Demands

War demands have brought a necessary increase in cutting activity over the entire State. Cutting in 1941 is estimated to have been 20 percent more for sawlog material and 7 percent more for pulpwood than in 1940. Incomplete data indicate that drain in 1942 may also be above that of 1940.

For the State as a whole the total volume of growing stock increased in 1940; in spite of increased cutting the indications are that the growing stock increased in volume in 1941; and there probably also will be a net increase in 1942. This does not mean that the balance between growth and drain is favorable everywhere in the State. In the Coastal Plain it is theoretically possible to increase drain on the shortleaf and loblolly pine growing stock by as much as 25 percent (over 1940) for perhaps 30 years with no loss in total volume although with virtual elimination of trees 20-inches and larger (table II). The oaks and Virginia pine could be cut somewhat more heavily than in 1940. But, shortleaf and loblolly pine in the Piedmont already were being seriously overcut in 1940 as was white-cedar and cypress in the Coastal Plain. Similar shortages exist in other species and localities. Likewise, because the figures for total growth include growth on inferior and non-commercial species, the effective net increment is less than the indicated State totals. Balances between growth and drain for the State as a whole, therefore, must be interpreted with caution and with full appreciation of local situations.

War needs are now drawing more heavily on the better species of high quality for special uses such as truck bodies, airplane veneer, and ship timbers. Other specialized war needs are developing. The indications are that war drain on the forest resource is not as likely to create a deficit in total volume of the growing stock as to cause an appreciable decrease in its quality. Thus, the proportion of inferior species in the growing stock will increase at the expense of the better quality trees, creating future problems of utilization.

APPENDIX

Table 1. - Land use in the State of
Virginia, 1940

Land use	Land area	
	Acres	Percent
Forest:		
Commercial	14,412,000	56.5
Public reserved	235,900	.9
Non-commercial	184,400	.7
Total	14,832,300	58.1
Non-forest:		
Crop-land	5,954,700	23.3
Abandoned crop-land	380,100	1.5
Pasture	3,424,300	13.4
Marsh	272,500	1.1
Other	671,500	2.6
Total	10,703,100	41.9
All uses	25,535,400	100.0

Table 2. - Forest area of Virginia by forest types and conditions, 1940

Forest type	Forest condition			Total	
	Saw timber	Cordwood	Reproduction		
	Acres	Acres	Acres	Acres	Percent
Softwoods:					
Loblolly pine[1]	1,329,100	580,400	106,300	2,015,800	14.0
Shortleaf pine[2]	1,010,500	870,400	90,200	1,971,100	13.7
Virginia pine	718,200	1,040,900	248,300	2,007,400	13.9
White pine[3]	165,900	68,600	1,600	236,100	1.6
Total	3,223,700	2,560,300	446,400	6,230,400	43.2
Hardwoods:					
Bottomland hardwood[4]	610,300	306,700	50,600	967,600	6.7
Cove hardwood[5]	316,800	238,400	3,300	558,500	3.9
Upland hardwood	3,004,000	3,447,900	203,600	6,655,500	46.2
Total	3,931,100	3,993,000	257,500	8,181,600	56.8
All types	7,154,800	6,553,300	703,900	14,412,000	100.0

[1] Includes pond pine, 12,100 acres.

[2] Includes redcedar hardwoods, total 61,600 acres.

[3] Includes hemlock, 74,400 acres.

[4] Includes cypress, 24,900 acres; white-cedar, 11,300 acres; and stream margin hardwoods, 25,900 acres.

[5] Includes northern hardwoods, 128,400 acres.

Table 3. - Species composition of forest types in Virginia, expressed in percent of net cubic volume, 1940

Species	Forest type							All types
	Loblolly pine	Short leaf pine	Virginia pine	White pine	Bottomland hardwood	Cove hardwood	Upland hardwood	
Softwoods:								
Pond pine	0.1	- -	- -	- -	negl.	- -	- -	negl.
Loblolly pine	72.7	2.6	4.4	- -	4.4	- -	1.5	17.9
Shortleaf pine	3.5	62.6	7.9	3.0	0.7	0.2	3.0	10.7
Virginia pine	1.6	6.0	56.3	1.8	0.4	0.5	1.6	7.8
White pine	- -	0.4	0.7	31.8	negl.	0.6	0.6	1.0
Hemlock	- -	negl.	negl.	21.8	negl.	1.6	0.2	0.6
Redcedar	0.1	0.9	0.3	0.2	0.1	0.1	0.2	0.3
White-cedar	negl.	- -	- -	- -	1.2	- -	negl.	0.1
Cypress	0.1	——	- -	- -	4.5	- -	negl.	0.5
Hardwoods:								
Red maple	0.9	0.7	0.7	1.9	8.6	3.2	2.3	2.3
Blackgum	1.8	0.6	0.8	0.8	19.9	1.5	2.6	3.7
Sweetgum	6.1	3.2	2.0	negl.	17.9	0.1	3.6	5.3
Yellowpoplar	2.5	4.7	6.2	3.2	8.5	34.5	9.5	7.8
Northern red oak	0.5	0.9	0.7	2.6	1.9	10.6	6.6	3.5
Other red oaks	3.6	6.5	7.3	7.7	4.2	2.9	16.8	9.5
White oak	3.5	4.8	6.3	8.0	3.4	4.3	19.8	10.3
Chestnut oak	negl.	1.5	0.8	4.7	negl.	4.1	13.2	5.6
Other white oaks	0.6	1.2	1.3	0.4	0.5	negl.	1.2	0.9
Birch	- -	negl.	negl.	1.4	negl.	2.8	0.2	0.2
Beech	0.4	0.1	0.4	- -	0.8	0.3	2.3	1.1
Hickory	0.7	1.2	1.6	1.8	1.0	4.9	7.7	3.8
Cherry-walnut	- -	negl.	negl.	0.1	0.1	1.3	0.4	0.2
Sugar maple	- -	negl.	negl.	1.7	negl.	4.2	0.4	0.3
Ash	0.1	0.2	0.2	0.3	6.0	2.3	0.6	1.0
Dogwood	0.4	0.4	0.8	0.1	0.8	1.2	0.9	0.7
Black locust	- -	0.1	0.1	0.7	negl.	1.9	1.2	0.6
Other hardwoods	0.5	0.9	0.7	4.9	14.0	15.5	2.5	3.5
Scrub hardwoods	0.3	0.5	0.5	1.1	1.1	1.4	1.1	0.8
All species	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4. - Net board-foot volume (Int. $\frac{1}{4}$-inch rule) in Virginia, by species and forest conditions, 1940

Species	Forest condition		Total	
	Saw timber	Cordwood[1]		
	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:				
Loblolly pine[2]	6,913,500	145,900	7,059,400	29.0
Shortleaf pine	2,492,800	220,700	2,713,500	11.2
Virginia pine	1,404,500	137,000	1,541,500	6.3
White pine	383,900	30,000	413,900	1.7
Hemlock[3]	240,100	11,600	251,700	1.0
Redcedar	31,500	9,700	41,200	.2
White-cedar	64,000	900	64,900	.3
Cypress	201,100	800	201,900	.8
Total	11,731,400	556,600	12,288,000	50.5
Hardwoods:				
Red maple	373,000	19,800	392,800	1.6
Blackgum	823,400	24,200	847,600	3.5
Sweetgum	989,500	31,700	1,021,200	4.2
Yellowpoplar	1,810,000	69,900	1,879,900	7.7
Northern red oak	1,030,400	33,700	1,064,100	4.4
Other red oaks	1,581,800	93,000	1,674,800	6.9
White oak	1,827,600	75,000	1,902,600	7.8
Chestnut oak	1,109,500	64,100	1,173,600	4.8
Other white oaks	101,200	6,800	108,000	.5
Birch	34,500	2,800	37,300	.2
Beech	276,900	8,800	285,700	1.2
Hickory	598,800	37,100	635,900	2.6
Cherry-walnut	42,400	7,800	50,200	.2
Sugar maple	92,400	4,100	96,500	.4
Ash	171,300	4,900	176,200	.7
Other hardwoods[4]	670,600	29,200	699,800	2.8
Total	11,533,300	512,900	12,046,200	49.5
All live species	23,264,700	1,069,500	24,334,200	100.0
Dead chestnut	444,400	314,000	758,400	- -
All species	23,709,100	1,383,500	25,092,600	- -

[1] Includes the saw-timber volume, 5,100 M board feet, in the reproduction condition.

[2] Includes pond pine, 3,500 M board feet.

[3] Includes red spruce, 2,700 M board feet.

[4] Includes basswood, 68,100 M board feet.

Table 5. - Net board-foot volume (Int. $\frac{1}{4}$-inch rule) in Virginia by species and diameter classes, 1940

Species	Diameter-class (inches)			Total	
	10-12	14-18	20 +		
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:					
Loblolly pine	2,858,400	3,221,600	979,400	7,059,400	29.0
Shortleaf pine	1,643,200	899,600	170,700	2,713,500	11.2
Virginia pine	1,094,400	429,300	17,800	1,541,500	6.3
White pine	117,900	161,700	134,300	413,900	1.7
Hemlock	35,200	81,100	135,400	251,700	1.0
Redcedar	32,200	8,200	800	41,200	.2
White-cedar	7,100	29,500	28,300	64,900	.3
Cypress	55,900	88,300	57,700	201,900	.8
Total	5,844,300	4,919,300	1,524,400	12,288,000	50.5
Hardwoods:					
Red maple	- -	255,600	137,200	392,800	1.6
Blackgum	- -	504,600	343,000	847,600	3.5
Sweetgum	- -	728,100	293,100	1,021,200	4.2
Yellowpoplar	- -	1,151,400	728,500	1,879,900	7.7
Northern red oak	- -	418,600	645,500	1,064,100	4.4
Other red oaks	- -	1,007,400	667,400	1,674,800	6.9
White oak	- -	968,700	933,900	1,902,600	7.8
Chestnut oak	- -	575,900	597,700	1,173,600	4.8
Other white oaks	- -	74,000	34,000	108,000	.5
Birch	- -	22,800	14,500	37,300	.2
Beech	- -	162,100	123,600	285,700	1.2
Hickory	- -	424,700	211,200	635,900	2.6
Cherry-walnut	- -	31,200	19,000	50,200	.2
Sugar maple	- -	39,200	57,300	96,500	.4
Ash	- -	125,800	50,400	176,200	.7
Other hardwoods	- -	419,200	280,600	699,800	2.8
Total	- -	6,909,300	5,136,900	12,046,200	49.5
All live species	5,844,300	11,828,600	6,661,300	24,334,200	100.0
Dead chestnut	- -	376,800	381,600	758,400	- -
All species	5,844,300	12,205,400	7,042,900	25,092,600	- -

Table 6. - Net board-foot volume (Int. ¼-inch rule) per acre in Virginia by forest conditions and types, 1940

Forest condition and species group	Forest type							All types
	Loblolly pine	Shortleaf pine	Virginia pine	White pine	Bottomland hardwood	Cove hardwood	Upland hardwood	
	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.
Saw timber:								
Loblolly and shortleaf pines	4,830	1,890	460	110	420	10	160	1,310
Virginia pine	60	150	1,430	50	20	10	40	200
Other softwoods	10	30	30	2,610	430	110	40	130
Oaks	190	220	380	610	420	900	1,420	790
Gums and yellowpoplar	310	190	240	110	1,980	1,120	420	510
Other hardwoods	70	40	70	290	1,050	970	360	310
All live species	5,470	2,520	2,610	3,780	4,320	3,120	2,440	3,250
Dead chestnut	- -	10	negl.	120	- -	210	120	60
Cordwood:								
Loblolly and shortleaf pines	130	110	20	40	30	negl.	30	50
Virginia pine	10	10	60	10	10	10	10	20
Other softwoods	negl.	10	10	210	10	10	10	10
Oaks	10	10	10	30	20	40	60	40
Gums and yellowpoplar	10	negl.	10	- -	50	70	20	20
Other hardwoods	10	10	negl.	20	40	70	20	10
All live species	170	150	110	310	160	200	150	150
Dead chestnut	- -	10	negl.	60	- -	120	70	40
All conditions:								
Loblolly and shortleaf pines	3,230	1,020	180	90	280	10	90	680
Virginia pine	40	90	550	40	10	10	20	110
Other softwoods	10	20	10	1,900	270	70	20	70
Oaks	130	120	140	440	270	530	680	410
Gums and yellowpoplar	210	100	90	70	1,270	660	200	260
Other hardwoods	50	20	30	210	680	580	170	160
All live species	3,670	1,370	1,000	2,750	2,780	1,860	1,180	1,690
Dead chestnut	- -	10	negl.	100	- -	170	90	50

Table 7. - Distribution of saw-timber area and volume (Int. $\frac{1}{4}$-inch rule) in Virginia by volume-per-acre classes and type groups, 1940

Volume-per-acre class (board feet)	Saw-timber area		Saw-timber volume	
	Acres	Percent	M bd. ft.	Percent
Softwood types:				
Less than 2,000	1,305,400	40.2	1,566,000	12.5
2,000-3,999	887,600	27.3	2,520,100	20.1
4,000-5,999	436,100	13.4	2,134,400	17.0
6,000-7,999	251,400	7.7	1,747,100	13.9
8,000-9,999	145,000	4.5	1,284,900	10.2
10,000 and over	225,600	6.9	3,299,500	26.3
Total	3,251,100	100.0	12,552,000	100.0
Hardwood types:				
Less than 2.000	2,046,100	52.4	2,381,600	22.2
2,000-3,999	1,074,400	27.5	3,057,800	28.6
4,000-5,999	435,300	11.2	2,121,800	19.8
6,000-7,999	173,600	4.4	1,191,600	11.1
8,000-9,999	85,700	2.2	763,800	7.1
10,000 and over	88,600	2.3	1,196,100	11.2
Total	3,903,700	100.0	10,712,700	100.0

Table 8. - Net cordwood volume in Virginia by species and sources of material, 1940

Species	Saw-timber trees		Cord-wood	Cull trees	All material
	Sawlogs	Upper stems			
	M cords	M cords	M cords	M cords	M cords
Softwoods:					
Loblolly pine	17,317.1	3,657.0	7,322.8	650.0	28,946.9
Shortleaf pine	7,772.9	2,208.8	7,439.1	691.0	18,111.8
Virginia pine	3,970.4	1,307.5	6,069.3	1,388.4	12,735.6
White pine	919.1	207.2	304.9	133.4	1,564.6
Hemlock	570.1	109.4	105.8	87.9	873.2
Redcedar	101.2	- -	262.2	4.4	367.8
White-cedar	151.0	13.7	5.4	-	170.1
Cypress	481.0	146.7	100.2	84.8	812.7
Total	31,282.8	7,650.3	21,609.7	3,039.9	63,582.7
Hardwoods:					
Red maple	1,076.0	624.6	2,139.6	2,671.9	6,512.1
Blackgum	2,424.2	1,284.8	2,693.0	2,483.7	8,885.7
Sweetgum	2,470.3	1,474.6	5,066.4	1,163.0	10,174.3
Yellowpoplar	4,933.5	2,679.5	6,145.7	1,279.0	15,037.7
Northern red oak	2,658.7	1,575.8	1,825.9	1,216.4	7,276.8
Other red oaks	4,799.4	2,605.1	9,187.2	2,494.8	19,086.5
White oak	5,203.9	2,925.1	9,575.9	2,428.2	20,133.1
Chestnut oak	3,547.1	1,897.4	4,812.0	5,180.8	15,437.3
Other white oaks	337.3	174.4	1,232.9	447.9	2,192.5
Birch	100.6	59.5	218.6	291.1	669.8
Beech	761.7	461.8	614.2	565.3	2,403.0
Hickory	1,962.6	1,069.4	3,687.7	981.2	7,700.9
Cherry-walnut	129.5	66.2	177.0	83.1	455.8
Sugar maple	259.2	158.5	159.5	315.2	892.4
Ash	461.2	247.6	1,065.0	633.0	2,406.8
Dogwood	- -	- -	1,160.0	288.6	1,448.6
Black locust	- -	- -	1,096.0	185.0	1,281.0
Other merchantable hardwoods	1,873.6	1,059.2	2,701.4	2,330.4	7,964.6
Scrub hardwoods	- -	- -	- -	1,355.8	1,355.8
Total	32,998.8	18,363.5	53,558.0	26,394.4	131,314.7
All live species	64,281.6	26,013.8	75,167.7	29,434.3	194,897.4
Dead chestnut	2,552.5	1,083.0	2,891.0	3,086.3	9,612.8
All species	66,834.1	27,096.8	78,058.7	32,520.6	204,510.2

Table 9. - Net cordwood volume in Virginia by species and diameter classes, 1940[1]

Species	Diameter class (inches)				Total	
	6-8	10-12	14 18	20+		
	M cords	M cords	M cords	M cords	M cords	Percent
Softwoods:						
Loblolly pine	7,322.8	10,193.4	8,558.4	2,222.3	28,296.9	19.3
Shortleaf pine	7,439.1	6,908.3	2,654.1	419.3	17,420.8	11.9
Virginia pine	6,069.3	4,018.5	1,214.4	45.0	11,347.2	7.7
White pine	304.9	392.6	428.5	305.2	1,431.2	1.0
Hemlock	105.8	134.8	224.8	319.9	785.3	.5
Redcedar	262.2	80.5	18.9	1.8	363.4	.2
White-cedar	5.4	22.2	77.0	65.5	170.1	.1
Cypress	100.2	155.3	207.3	118.4	581.2	.4
Total	21,609.7	21,905.6	13,383.4	3,497.4	60,396.1	41.1
Hardwoods:						
Red maple	1,065.8	1,073.8	727.2	348.8	3,215.6	2.2
Blackgum	1,043.2	1,649.8	1,529.2	895.0	5,117.2	3.5
Sweetgum	2,310.0	2,756.4	1,817.7	652.6	7,536.7	5.1
Yellowpoplar	2,795.3	3,350.4	3,167.2	1,766.3	11,079.2	7.5
Northern red oak	754.1	1,071.8	1,165.0	1,493.7	4,484.6	3.1
Other red oaks	4,252.6	4,934.6	3,078.0	1,721.4	13,986.6	9.5
White oak	4,201.5	5,374.4	2,860.5	2,343.4	14,779.8	10.1
Chestnut oak	2,142.7	2,669.3	1,845.7	1,701.4	8,359.1	5.7
Other white oaks	541.0	691.9	244.2	93.1	1,570.2	1.1
Birch	95.5	123.1	65.9	34.7	319.2	.2
Beech	223.0	391.2	460.2	301.5	1,375.9	.9
Hickory	1,570.1	2,117.6	1,389.1	573.5	5,650.3	3.8
Cherry-walnut	72.0	105.0	84.8	44.7	306.5	.2
Sugar maple	80.6	78.9	112.2	147.0	418.7	.3
Ash	545.1	519.9	341.3	119.9	1,526.2	1.0
Dogwood	723.7	329.2	99.0	8.1	1,160.0	.8
Black locust	515.5	366.5	166.7	47.3	1,096.0	.7
Other merch. hdwds.	1,159.6	1,541.8	1,190.5	683.1	4,575.0	3.2
Total	24,091.3	29,145.6	20,344.4	12,975.5	86,556.8	58.9
All live species	45,701.0	51,051.2	33,727.8	16,472.9	146,952.9	100.0
Dead chestnut	1,043.7	1,847.3	2,496.1	3,142.7	8,529.8	- -
All species	46,744.7	52,898.5	36,223.9	19,615.6	155,482.7	- -

[1] This table differs from table 8 in that the volume contained in cull trees and upper stems and limbs of saw-timber-size hardwoods is not included.

Table 10. Cordwood volume per acre in Virginia, by forest conditions and types, 1940

Forest condition and species group	Forest type: Lob-lolly pine	Short-leaf pine	Vir-ginia pine	White pine	Bottom land hard-wood	Cove hard-wood	Up-land hard-wood	All types
	Cords	Cords	Cords	Cords	Cords	Cords	Cords	Cords
Saw timber:								
Loblolly and shortleaf pines	18.34	10.68	2.31	.43	1.23	.04	.59	5.51
Virginia pine	.37	.81	8.24	.26	.07	.05	.20	1.11
Other softwoods	.03	.15	.15	8.15	1.20	.38	.13	.40
Oaks	1.86	2.17	2.70	3.33	2.01	3.23	7.13	4.31
Gums and yellowpoplar	2.33	1.28	1.49	.60	9.79	5.22	2.18	2.76
Other hardwoods	.65	.53	.74	1.76	6.23	5.39	2.45	2.11
All live species	23.58	15.62	15.63	14.53	20.53	14.31	12.68	16.20
Dead chestnut	- -	.15	.07	1.15	.04	1.73	1.32	.69
Cordwood:								
Loblolly and shortleaf pines	3.35	2.57	.37	.26	.20	.02	.26	.87
Virginia pine	.09	.27	2.16	.10	.04	.05	.08	.47
Other softwoods	.02	.10	.03	1.62	.05	.06	.04	.06
Oaks	.54	.74	.52	1.32	.48	.76	2.78	1.70
Gums and yellowpoplar	.47	.29	.27	.20	1.54	2.31	.53	.55
Other hardwoods	[illegible]	.17	.17	.80	1.81	2.09	.78	.63
All live species	4.60	4.14	3.52	4.30	4.12	5.29	4.47	4.28
Dead chestnut	- -	.10	.12	.73		.97	.83	.50
All conditions:								
Loblolly and shortleaf pines	13.23	6.73	1.06	.38	.85	.03	.41	3.17
Virginia pine	.28	.55	4.34	.21	.06	.05	.13	.79
Other softwoods	.03	.13	.08	6.21	.78	.25	.08	.23
Oaks	1.41	1.48	1.30	2.73	1.44	2.16	4.75	3.00
Gums and yellowpoplar	1.69	.79	.70	.48	6.74	3.96	1.27	1.65
Other hardwoods	.47	.35	.37	1.48	4.60	3.96	1.54	1.36
All live species	17.11	10.03	7.85	11.49	14.47	10.41	8.18	10.20
Dead chestnut	- -	.12	.10	1.02	.03	1.40	1.06	.59

Table 11. - Net cubic-foot volume of all sound material in Virginia by species and sources of material, 1940

Species	Saw-timber trees		Cord-wood	Cull trees	All material
	Sawlogs	Upper stems			
	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Softwoods:					
Loblolly pine	1,213.4	254.9	475.6	44.6	1,988.5
Shortleaf pine	531.9	152.5	476.8	46.7	1,207.9
Virginia pine	305.0	89.5	447.4	103.0	944.9
White pine	71.6	15.3	23.2	10.2	120.3
Hemlock	45.1	8.6	8.0	6.9	68.6
Redcedar	7.9	- -	20.0	.2	28.1
White-cedar	12.0	.9	.4	- -	13.3
Cypress	37.1	9.0	7.1	6.7	59.9
Total	2,224.0	530.7	1,458.5	218.3	4,431.5
Hardwoods:					
Red maple	73.1	37.7	141.2	178.0	430.0
Blackgum	159.8	74.5	169.7	163.0	567.0
Sweetgum	167.8	87.6	311.8	73.6	640.8
Yellowpoplar	315.8	149.3	381.8	82.5	929.4
Northern red oak	178.7	92.1	110.2	79.0	460.0
Other red oaks	313.0	150.7	563.2	157.4	1,184.3
White oak	342.7	167.4	600.0	156.3	1,266.4
Chestnut oak	221.7	103.6	277.6	319.5	922.4
Other white oaks	21.3	9.6	71.2	26.8	128.9
Birch	7.0	3.6	14.2	19.6	44.4
Beech	52.8	28.3	40.8	37.7	159.6
Hickory	126.4	58.7	221.1	60.7	466.9
Cherry-walnut	8.7	3.8	10.8	5.3	28.6
Sugar maple	17.7	9.4	10.6	21.3	59.0
Ash	29.8	13.9	65.8	40.0	149.5
Dogwood	- -	- -	74.7	18.3	93.0
Black locust	- -	- -	61.0	10.1	71.1
Other merchantable hardwoods	129.0	64.5	180.9	153.1	527.5
Scrub hardwoods	- -	- -	- -	82.9	82.9
Total	2,165.3	1,054.7	3,306.6	1,685.1	8,211.7
All species	4,389.3	1,585.4	4,765.1	1,903.4	12,643.2

Table 12. - Volume of wood processed in Virginia by the primary forest-products industries, 1940

Product	Number of plants	Production or consumption					
		Loblolly, shortleaf, and Virginia pines	Other softwoods	Oaks	Gums yellow-poplar	Other hardwoods	Total
		M bd. ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd. ft.
Lumber[1]	2,762	679,000	44,800	187,000	117,700	44,000	1,072,500
Veneer	15	1,000	600	1,500	31,800	2,200	37,100
		Cords	Cords	Cords	Cords	Cords	Cords
Cooperage	69	98,200	- -	5,300	3,600	100	107,200
Pulpwood	9	691,200	- -	11,200	62,500	69,400	834,300
Excelsior	20	42,700	- -	- -	- -	- -	42,700
Tanning ext.[2]	9	- -	- -	8,400	- -	97,900	106,300
Mine timbers	- -	9,100	1,200	35,200	14,400	41,800	101,700
Fuel wood	- -	1,364,300	41,100	1,586,900	367,000	537,800	3,897,100
Fence posts	- -	1,300	26,200	17,800	300	67,700	113,300
Misc.[3]	34	200	17,000	2,200	500	14,400	34,300
		M pcs.	M pcs.	M pcs.	M pcs.	M pcs.	M pcs.
Poles, piles	- -	118	- -	1	6	3	128
Hewn ties	- -	7	5	519	2	- -	533

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[1] Includes lumber tally equivalent of all material produced in sawmills.

[2] Includes chestnut wood and oak bark used for manufacture of tanning extract.

[3] Includes 13 handle plants, 5 wood turning plants, 5 insulator pin plants, 3 shingle mills, 1 dimension stock plant, 2 box plants, 1 picker stick plant, 1 wooden utensil plant, 1 mine wedge plant, 1 shuttle block plant, and 1 cedar chest plant.

Table 13. - Volume of wood cut from the sound-tree growing stock (commodity drain) in Virginia, 1940

Product and source of material	Virginia pine	Loblolly and shortleaf pines	Other softwoods	Oaks	Gums, yellow-poplar	Other hardwoods	Total
	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.
Sawlogs:							
Lumber	82,800	503,600	39,400	174,900	102,600	27,100	930,400
Veneer	- -	700	200	900	23,900	2,500	28,200
Cooperage	300	25,500	- -	1,700	500	100	28,100
Pulpwood	29,100	92,200	- -	2,700	5,700	1,900	131,600
Excelsior	300	6,900	- -	- -	- -	- -	7,200
Mine timbers	100	1,300	200	2,300	500	2,800	7,200
Fuel wood	19,600	50,700	- -	21,800	4,000	3,500	99,600
Fence posts	100	100	3,800	2,300	100	1,000	7,400
Poles, piles	- -	14,800	- -	300	500	300	15,900
Hewn ties	- -	200	- -	24,400	- -	- -	24,600
Misc.	- -	- -	1,600	600	300	3,200	5,700
Total	132,300	696,000	45,200	231,900	138,100	42,400	1,285,900
	Cords	Cords	Cords	Cords	Cords	Cords	Cords
All mt'l:[1]							
Lumber	271,800	1,460,500	98,600	524,600	291,700	78,500	2,725,700
Veneer	- -	1,800	400	2,400	61,600	6,700	72,900
Cooperage	1,300	96,000	- -	4,600	3,600	100	105,600
Pulpwood	159,900	441,300	- -	17,500	55,500	12,300	686,500
Excelsior	2,300	38,900	- -	- -	- -	- -	41,200
Mine timbers	600	8,400	1,200	35,200	14,500	41,800	101,700
Fuel wood	169,500	277,200	- -	467,500	104,300	111,300	1,129,800
Fence posts	500	800	25,100	16,100	200	58,500	101,200
Poles, piles	300	44,000	- -	800	1,400	900	47,400
Hewn ties	- -	900	100	93,700	100	- -	94,800
Misc.	- -	100	8,500	2,200	400	13,000	24,200
Total	606,200	2,369,900	133,900	1,164,600	533,300	323,100	5,131,000

[1] Includes the sawlog portion of saw-timber trees, the usable volume in the upper stems of softwood saw timber and in small trees from 5.0 inches d.b.h. to saw-timber size.

Table 14. – The effect of growth, mortality, and commodity drain upon the forest growing stock in Virginia, 1940

IN BOARD FEET (INT. ¼-INCH RULE)

Species and diameter group	Growing stock Jan. 1, 1940	Gross growth	Mortality	Net growth	Commodity drain	Net change	Growing stock Jan. 1, 1941
	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.
Softwoods:							
10-12 inches	5,810.7	366.8	21.7	345.1	329.1	16.0	5,826.7
14-18 inches	4,925.9	405.8	21.6	384.2	360.6	23.6	4,949.5
20 and over	1,529.5	144.5	10.1	134.4	183.8	-49.4	1,480.1
Total	12,266.1	917.1	53.4	863.7	873.5	-9.8	12,256.3
Hardwoods:							
14-18 inches	6,825.7	489.5	15.3	474.2	220.1	254.1	7,079.8
20 and over	5,104.3	289.8	16.4	273.4	192.3	81.1	5,185.4
Total	11,930.0	779.3	31.7	747.6	412.4	335.2	12,265.2
All species	24,196.1	1,696.4	85.1	1,611.3	1,285.9	325.4	24,521.5

IN CUBIC FEET

	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Softwoods:							
6-8 inches	1,445.2	75.6	10.7	64.9	32.5	32.4	1,477.6
10-12 inches	1,507.8	92.7	5.8	86.9	84.9	2.0	1,509.8
14-18 inches	966.2	86.5	4.3	82.2	71.6	10.6	976.8
20 and over	264.8	25.5	1.7	23.8	31.3	-7.5	257.3
Total	4,184.0	280.3	22.5	257.8	220.3	37.5	4,221.5
Hardwoods:							
6-12 inches	3,249.8	144.9	8.6	136.3	55.6	80.7	3,330.5
14-18 inches	1,302.2	90.3	3.0	87.3	41.3	46.0	1,348.2
20 and over	862.7	48.8	3.0	45.8	32.9	12.9	875.6
Total	5,414.7	284.0	14.6	269.4	129.8	139.6	5,554.3
All species	9,598.7	564.3	37.1	527.2	350.1	177.1	9,775.8

Table 15. - Net changes in saw-timber growing stock in Virginia and its provinces by species groups and diameter classes, 1940

Province and diameter group	Species-groups								
	Shortleaf and loblolly pines	Virginia pine	Other soft-woods	All soft-woods	Oaks	Gums, yellow-poplar	Other hard-woods	All hard-woods	All species
	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.
Coastal Plain:									
10-12 inches	-4.4	-5.3	-2.7	-12.4	- -	- -	- -	- -	-12.4
14-18 inches	49.2	1.1	-0.1	50.2	25.3	57.2	19.8	102.3	152.5
20 and over	-23.2	0.2	-3.2	-26.2	5.6	6.6	16.6	28.8	2.6
All diameters	21.6	-4.0	-6.0	11.6	30.9	63.8	36.4	131.1	142.7
Piedmont:									
10-12 inches	-27.1	39.3	-0.1	12.1	- -	- -	- -	- -	12.1
14-18 inches	-28.9	5.5	0.4	-23.0	58.2	43.0	28.5	129.7	106.7
20 and over	-17.7	-0.3	0.1	-17.9	22.3	19.0	13.8	55.1	37.2
All diameters	-73.7	44.5	0.4	-28.8	80.5	62.0	42.3	184.8	156.0
Mountains:									
10-12 inches	3.3	8.4	4.6	16.3	- -	- -	- -	- -	16.3
14-18 inches	2.9	-0.5	-6.0	-3.6	2.4	7.8	11.9	22.1	18.5
20 and over	- -	- -	-5.3	-5.3	-6.8	2.1	1.9	-2.8	-8.1
All diameters	6.2	7.9	-6.7	7.4	-4.4	9.9	13.8	19.3	26.7
All provinces:									
10-12 inches	-28.2	42.4	1.8	16.0	- -	- -	- -	- -	16.0
14-18 inches	23.2	6.1	-5.7	23.6	85.9	108.0	60.2	254.1	277.7
20 and over	-40.9	-0.1	-8.4	-49.4	21.1	27.7	32.3	81.1	31.7
All diameters	-45.9	48.4	-12.3	-9.8	107.0	135.7	92.5	335.2	325.4

Table 16. - Net changes in growing stock of all material in Virginia and its provinces by species groups and diameter classes, 1940

Province and diameter group	Species-groups								
	Shortleaf and loblolly pines	Virginia pine	Other soft-woods	All soft-woods	Oaks	Gums, yellow-poplar	Other hard-woods	All hard-woods	All species
	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Coastal Plain:									
6-8 inches	6.6	2.5	-0.8	8.3	5.5	9.5	4.9	19.9	28.2
10-12 inches	-2.9	-1.8	-0.5	-5.2	3.0	3.9	1.5	8.4	3.2
14-18 inches	13.1	0.3	negl.	13.4	4.9	9.1	3.6	17.6	31.0
20 and over	-2.9	negl.	-0.5	-3.4	1.0	1.1	2.8	4.9	1.5
All diameters	13.9	1.0	-1.8	13.1	14.4	23.6	12.8	50.8	63.9
Piedmont:									
6-8 inches	5.2	14.8	1.0	21.0	6.7	8.4	9.0	24.1	45.1
10-12 inches	-7.9	11.1	negl.	3.2	1.9	4.2	2.9	9.0	12.2
14-18 inches	-4.4	1.9	0.1	-2.4	11.5	6.7	6.0	24.2	21.8
20 and over	-3.2	negl.	0.1	-3.1	3.7	2.8	1.9	8.4	5.3
All diameters	-10.3	27.8	1.2	18.7	23.8	22.1	19.8	65.7	84.4
Mountains:									
6-8 inches	-0.8	2.5	1.4	3.1	6.9	1.2	9.0	17.1	20.2
10-12 inches	0.8	2.0	1.2	4.0	1.7	-0.2	0.7	2.2	6.2
14-18 inches	0.8	negl.	-1.2	-0.4	0.5	0.7	3.0	4.2	3.8
20 and over	negl.	-- --	-1.0	-1.0	-1.2	0.3	0.5	-0.4	-1.4
All diameters	0.8	4.5	0.4	5.7	7.9	2.0	13.2	23.1	28.8
All provinces:									
6-8 inches	11.0	19.8	1.6	32.4	19.1	19.1	22.9	61.1	93.5
10-12 inches	-10.0	11.3	0.7	2.0	6.6	7.9	5.1	19.6	21.6
14-18 inches	9.5	2.2	-1.1	10.6	16.9	16.5	12.6	46.0	56.6
20 and over	-6.1	negl.	-1.4	-7.5	3.5	4.2	5.2	12.9	5.4
All diameters	[illegible]	33.3	-0.2	37.5	46.1	47.7	45.8	139.6	177.1

Table 1. - Land use in the Virginia
Coastal Plain, 1940

Land use	Land area	
	Acres	Percent
Forest:		
Commercial	3,919,200	61.6
Public reserved	24,600	.4
Non-commercial	- -	- -
Total	3,943,800	62.0
Non-forest:		
Crop-land	1,684,400	26.5
Abandoned crop-land	82,100	1.3
Pasture	150,500	2.4
Marsh	258,300	4.0
Other	243,800	3.8
Total	2,419,100	38.0
All uses	6,362,900	100.0

Table 2. - Forest area of the Virginia Coastal Plain by forest types and conditions, 1940

Forest type	Forest condition			Total	
	Saw timber	Cordwood	Reproduction		
	Acres	Acres	Acres	Acres	Percent
Softwoods:					
Loblolly pine[1/]	1,279,600	548,800	91,000	1,919,400	49.0
Shortleaf pine	94,100	65,200	4,800	164,100	4.2
Virginia pine	172,200	135,200	23,400	330,800	8.4
White pine	- -	- -	- -	- -	- -
Total	1,545,900	749,200	119,200	2,414,300	61.6
Hardwoods:					
Bottomland hardwood[2/]	409,700	160,100	37,800	607,600	15.5
Cove hardwood	- -	- -	- -	- -	- -
Upland hardwood	521,500	367,000	8,800	897,300	22.9
Total	931,200	527,100	46,600	1,504,900	38.4
All types	2,477,100	1,276,300	165,800	3,919,200	100.0

1/Includes pond pine, 12,100 acres.

2/Includes cypress, 24,900 acres; and white-cedar, 11,300 acres.

Table 3. - Species composition of forest types in Virginia Coastal Plain, expressed in percent of net cubic volume, 1940

Species	Forest type							All types
	Loblolly pine	Shortleaf pine	Virginia pine	White pine	Bottomland hardwood	Cove hardwood	Upland hardwood	
Softwoods:								
Pond pine	0.1	- -	- -	- -	negl.	- -	- -	negl.
Loblolly pine	73.0	17.4	19.9	- -	5.9	- -	7.2	43.0
Shortleaf pine	3.3	52.7	2.8	- -	0.1	- -	1.2	4.0
Virginia pine	1.6	1.2	41.9	- -	0.1	- -	1.5	3.6
White pine	- -	- -	- -	- -	- -	- -	- -	- -
Hemlock	- -	- -	- -	- -	- -	- -	- -	- -
Redcedar	0.1	0.8	0.1	- -	0.1	- -	0.1	0.1
White-cedar	negl.	- -	- -	- -	1.6	- -	negl.	0.3
Cypress	0.1	- -	- -	- -	6.3	- -	negl.	1.2
Hardwoods:								
Red maple	0.9	0.5	0.4	- -	9.0	- -	2.5	2.7
Blackgum	1.8	0.8	1.3	- -	27.3	- -	3.0	6.8
Sweetgum	6.0	5.3	4.1	- -	18.8	- -	12.2	9.4
Yellowpoplar	2.5	2.4	5.1	- -	5.8	- -	13.1	5.3
Northern red oak	0.5	0.6	0.4	- -	1.7	- -	3.2	1.3
Other red oaks	3.6	7.4	9.9	- -	3.6	- -	15.3	6.4
White oak	3.5	5.6	7.5	- -	3.2	- -	18.0	6.5
Chestnut oak	negl.	0.1	- -	- -	- -	- -	0.8	0.2
Other white oaks	0.6	2.4	1.2	- -	0.4	- -	1.6	0.8
Birch	- -	- -	- -	- -	- -	- -	- -	- -
Beech	0.5	0.2	1.4	- -	0.8	- -	8.2	2.0
Hickory	0.7	1.1	2.3	- -	0.9	- -	7.2	2.1
Cherry-walnut	- -	- -	- -	- -	- -	- -	- -	- -
Sugar maple	- -	- -	- -	- -	- -	- -	- -	- -
Ash	0.1	0.1	negl.	- -	5.2	- -	0.5	1.1
Dogwood	0.4	0.4	0.9	- -	0.7	- -	1.5	0.7
Black locust	- -	- -	- -	- -	- -	- -	- -	- -
Other hardwoods	0.4	0.6	0.4	- -	7.3	- -	2.0	2.0
Scrub hardwoods	0.3	0.4	0.4	- -	1.2	- -	0.9	0.5
All species	100.0	100.0	100.0	- -	100.0	- -	100.0	100.0

Table 4. - Net board-foot volume (Int. $\frac{1}{4}$-inch rule) in the Virginia Coastal Plain by species and forest conditions, 1940

Species	Forest condition		Total	
	Saw timber	Cordwood[1]		
	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:				
Loblolly pine[2]	6,698,200	141,200	6,839,400	58.2
Shortleaf pine	433,400	16,600	450,000	3.8
Virginia pine	336,200	16,300	352,500	3.0
White pine	- -	- -	- -	- -
Hemlock	- -	- -	- -	- -
Redcedar	8,900	1,600	10,500	.1
White-cedar	64,000	900	64,900	.6
Cypress	201,100	800	201,900	1.7
Total	7,741,800	177,400	7,919,200	67.4
Hardwoods:				
Red maple	213,700	8,200	221,900	1.9
Blackgum	639,800	8,400	648,200	5.5
Sweetgum	756,100	21,800	777,900	6.6
Yellowpoplar	519,600	10,100	529,700	4.5
Northern red oak	149,400	2,800	152,200	1.3
Other red oaks	433,300	13,000	446,300	3.8
White oak	347,300	15,700	363,000	3.1
Chestnut oak	15,500	200	15,700	.2
Other white oaks	34,700	700	35,400	.3
Birch	- -	- -	- -	- -
Beech	218,200	5,400	223,600	1.9
Hickory	138,800	6,400	145,200	1.2
Cherry-walnut	- -	- -	- -	- -
Sugar maple	- -	- -	- -	- -
Ash	91,800	- -	91,800	.8
Other hardwoods	175,000	2,900	177,900	1.5
Total	3,733,200	95,600	3,828,800	32.6
All live species	11,475,000	273,000	11,748,000	100.0
Dead chestnut	- -	- -	- -	- -
All species	11,475,000	273,000	11,748,000	- -

[1] Includes the saw-timber volume, 2,000 M board feet, in the reproduction condition.

[2] Includes pond pine, 3,500 M board feet.

Table 5. - Net board-foot volume (Int. $\frac{1}{4}$-inch rule) in the Virginia Coastal Plain by species and diameter classes, 1940

Species	Diameter-class (inches)			Total	
	10-12	14-18	20+		
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:					
Loblolly pine	2,749,900	3,126,900	962,600	6,839,400	58.2
Shortleaf pine	277,700	150,400	21,900	450,000	3.8
Virginia pine	203,600	137,800	11,100	352,500	3.0
White pine	- -	- -	- -	- -	- -
Hemlock	- -	- -	- -	- -	- -
Redcedar	6,400	3,300	800	10,500	.1
White-cedar	7,100	29,500	28,300	64,900	.6
Cypress	55,900	88,300	57,700	201,900	1.7
Total	3,300,600	3,536,200	1,082,400	7,919,200	67.4
Hardwoods:					
Red maple	- -	145,300	76,600	221,900	1.9
Blackgum	- -	366,000	282,200	648,200	5.5
Sweetgum	- -	544,600	233,300	777,900	6.6
Yellowpoplar	- -	317,600	212,100	529,700	4.5
Northern red oak	- -	48,600	103,600	152,200	1.3
Other red oaks	- -	244,300	202,000	446,300	3.8
White oak	- -	222,100	140,900	363,000	3.1
Chestnut oak	- -	6,800	8,900	15,700	.2
Other white oaks	- -	23,100	12,300	35,400	.3
Birch	- -	- -	- -	- -	- -
Beech	- -	116,700	106,900	223,600	1.9
Hickory	- -	92,300	52,900	145,200	1.2
Cherry-walnut	- -	- -	- -	- -	- -
Sugar maple	- -	- -	- -	- -	- -
Ash	- -	63,100	28,700	91,800	.8
Other hardwoods	- -	109,800	68,100	177,900	1.5
Total	- -	2,300,300	1,528,500	3,828,800	32.6
All live species	3,300,600	5,836,500	2,610,900	11,748,000	100.0
Dead chestnut	- -	- -	- -	- -	- -
All species	3,300,600	5,836,500	2,610,900	11,748,000	- -

Table 6. - Net board-foot volume (Int. $\frac{1}{4}$-inch rule) per acre in the Virginia Coastal Plain by forest conditions and types, 1940

Forest condition and species group	Forest type							All types
	Loblolly pine	Shortleaf pine	Virginia pine	White pine	Bottomland hardwood	Cove hardwood	Upland hardwood	
	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.
Saw timber:								
Loblolly and shortleaf pines	4,880	2,850	940	- -	550	- -	440	2,880
Virginia pine	60	20	1,250	- -	10	- -	70	130
Other softwoods	10	10	negl.	- -	630	- -	negl.	110
Oaks	190	260	400	- -	420	- -	910	400
Gums and yellowpoplar	310	200	220	- -	2,450	- -	880	770
Other hardwoods	80	40	90	- -	940	- -	640	340
All live species	5,530	3,380	2,900	- -	5,000	- -	2,940	4,630
Dead chestnut	- -	- -	- -	- -	- -	- -	- -	- -
Cordwood:								
Loblolly and shortleaf pines	140	190	60	- -	50	- -	100	110
Virginia pine	negl.	10	50	- -	negl.	- -	10	10
Other softwoods	negl.	negl.	- -	- -	10	- -	negl.	negl.
Oaks	20	10	negl.	- -	10	- -	50	20
Gums and yellowpoplar	20	20	20	- -	60	- -	40	30
Other hardwoods	negl.	- -	negl.	- -	40	- -	40	20
All live species	180	230	130	- -	170	- -	240	190
Dead chestnut	- -	- -	- -	- -	- -		- -	- -
All conditions:								
Loblolly and shortleaf pines	3,300	1,710	510	- -	390	- -	290	1,860
Virginia pine	40	20	680	- -	10	- -	50	90
Other softwoods	10	10	negl.	- -	430	- -	negl.	70
Oaks	130	160	210	- -	290	- -	550	260
Gums and yellowpoplar	210	120	120	- -	1,670	- -	530	500
Other hardwoods	50	20	50	- -	640	- -	390	220
All live species	3,740	2,040	1,570	- -	3,430	- -	1,810	3,000
Dead chestnut	- -	- -	- -	- -	- -	- -	- -	- -

Table 7. - Distribution of saw-timber area and volume (Int. $\frac{1}{4}$-inch rule) in the Virginia Coastal Plain by volume-per-acre classes and type groups, 1940

Volume-per-acre class (board feet)	Saw-timber area		Saw-timber volume	
	Acres	Percent	M bd. ft.	Percent
Softwood types:				
Less than 2,000	441,000	28.0	560,900	6.9
2,000-3,999	399,200	25.4	1,154,200	14.2
4,000-5,999	242,200	15.4	1,195,200	14.7
6,000-7,999	175,400	11.2	1,225,400	15.1
8,000-9,999	115,100	7.3	1,016,400	12.5
10,000 and over	200,400	12.7	2,969,600	36.6
Total	1,573,300	100.0	8,121,700	100.0
Hardwood types:				
Less than 2,000	342,900	37.9	428,800	12.8
2,000-3,999	278,400	30.8	811,400	24.2
4,000-5,999	133,600	14.8	654,400	19.5
6,000-7,999	66,800	7.4	459,800	13.7
8,000-9,999	32,200	3.6	289,800	8.6
10,000 and over	49,900	5.5	709,100	21.2
Total	903,800	100.0	3,353,300	100.0

Table 8. Net [illegible] in the Virginia Coastal Plain, by species and [illegible] material, 1940

Species	Saw-timber trees		Cordwood	Cull trees	All material
	Saw logs	Upper stems			
	M cords	M cords	M cords	M cords	M cords
Softwoods:					
Loblolly pine	16,[illegible]8.4	3,[illegible]	[illegible]	638.7	[illegible]
Shortleaf pine	[illegible]	282.6	[illegible]	46.8	2,608.9
Virginia pine	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
White pine	--	--	--	--	--
Hemlock	--	-	--	[illegible]	--
Redcedar	[illegible]	--	[illegible]	2.6	[illegible]
White-cedar	[illegible]1.0	[illegible]	[illegible]	--	[illegible]
Cypress	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	9,369.0	991.9	[illegible]
Hardwoods:					
Red maple	601.6	[illegible]	[illegible]	[illegible]	[illegible]
Blackgum	1,834.[illegible]	1,025.5	1,803.6	1,708.2	[illegible]
Sweetgum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Yellow-poplar	[illegible]	[illegible]	[illegible]	290.2	[illegible]
Northern red oak	[illegible]79.[illegible]	[illegible]	[illegible]	59.3	[illegible]
Other red oaks	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
White oak	[illegible],018.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Chestnut oak	[illegible]	[illegible]	[illegible]	[illegible]	138.6
Other white oaks	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Birch	-	--	--	-	--
Beech	[illegible]	[illegible]	401.8	[illegible]	[illegible]
Hickory	[illegible]29.2	[illegible]	[illegible]	[illegible]	[illegible]
Cherry-walnut	--	--	--	--	--
Sugar maple	--	-	--	--	--
Ash	232.8	[illegible]	[illegible]	[illegible]	[illegible]
Dogwood			464.5		
Black locust	--	-	--	-	
Other merchantable hardwoods	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Scrub hardwoods	--	--	-	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
All live species	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dead chestnut	--	--	-	-	-
All species	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 9. - Net cordwood volume in the Virginia Coastal Plain by species and diameter classes, 1940[1]

Species	Diameter class (inches)				Total	
	6-8	10-12	14-18	20+		
	M cords	M cords	M cords	M cords	M cords	Percent
Softwoods:						
Loblolly pine	7,001.1	9,796.3	8,303.2	2,183.3	27,283.9	45.5
Shortleaf pine	1,107.7	1,006.3	399.5	48.6	2,562.1	4.3
Virginia pine	1,107.2	802.5	401.3	28.7	2,339.7	3.9
White pine	- -	- -	- -	- -	- -	- -
Hemlock	- -	- -	- -	- -	- -	- -
Redcedar	47.4	15.5	7.4	1.8	72.1	negl.
White-cedar	5.4	22.2	77.0	65.5	170.1	.3
Cypress	100.2	155.3	207.3	118.4	581.2	1.0
Total	9,369.0	11,798.1	9,395.7	2,446.3	33,009.1	55.0
Hardwoods:						
Red maple	386.5	449.0	410.3	191.3	1,437.1	2.4
Blackgum	652.9	1,150.7	1,101.2	733.5	3,638.3	6.1
Sweetgum	1,578.6	1,949.1	1,359.0	520.8	5,407.5	9.0
Yellowpoplar	710.2	926.4	841.9	488.2	2,966.7	4.9
Northern red oak	118.5	144.8	137.4	242.1	642.8	1.1
Other red oaks	1,187.8	1,383.2	734.2	502.2	3,807.4	6.3
White oak	1,370.4	1,674.1	669.8	348.9	4,063.2	6.8
Chestnut oak	6.5	41.3	20.4	22.1	90.3	.2
Other white oaks	206.0	243.3	69.1	30.5	548.9	.9
Birch	- -	- -	- -	- -	- -	- -
Beech	136.1	265.7	328.9	258.6	989.3	1.6
Hickory	339.3	433.3	288.2	141.0	1,201.8	2.0
Cherry-walnut	- -	- -	- -	- -	- -	- -
Sugar maple	- -	- -	- -	- -	- -	- -
Ash	215.5	209.2	166.1	66.7	657.5	1.1
Dogwood	285.1	140.0	36.7	2.7	464.5	.8
Black locust	- -	- -	- -	- -	- -	- -
Other merch. hdwds.	282.4	361.9	299.3	154.1	1,097.7	1.8
Total	7,475.8	9,372.0	6,462.5	3,702.7	27,013.0	45.0
All live species	16,844.8	21,170.1	15,858.2	6,149.0	60,022.1	100.0
Dead chestnut	- -	- -		- -	- -	- -
All species	16,844.8	21,170.1	15,858.2	6,149.0	60,022.1	- -

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[1] This table differs from table 8 in that the volume contained in cull trees and upper stems and limbs of saw-timber-size hardwoods is not included.

Table 10. - Cordwood volume per acre in the Virginia Coastal Plain, by forest conditions and types, 1940

Forest condition and species group	Forest type							All types
	Loblolly pine	Shortleaf pine	Virginia pine	White pine	Bottom-land hardwood	Cove hardwood	Upland hardwood	
	Cords	Cords	Cords	Cords	Cords	Cords	Cords	Cords
Saw timber:								
Loblolly and shortleaf pines	18.43	13.53	4.01	- -	1.55	- -	1.43	10.87
Virginia pine	.38	.19	7.08	- -	.03	- -	.30	.76
Other softwoods	.03	.08	.02	- -	1.76	- -	.02	.32
Oaks	1.87	2.86	3.19	- -	1.93	- -	5.95	2.87
Gums and yellowpoplar	2.29	1.54	1.72	- -	11.77	- -	4.79	4.31
Other hardwoods	.65	.55	.89	- -	5.36	- -	3.58	2.06
All live species	23.65	18.75	16.91	- -	22.40	- -	16.07	21.19
Dead chestnut	- -	- -	- -	- -	- -	- -	——	- -
Cordwood:								
Loblolly and shortleaf pines	3.42	4.14	.87	- -	.25	- -	.67	2.02
Virginia pine	.10	.12	2.16	- -	.01	- -	.09	.31
Other softwoods	.01	.14	negl.	- -	.06	- -	.01	.02
Oaks	.57	1.31	.68	- -	.49	- -	3.70	1.43
Gums and yellowpoplar	.49	.48	.45	- -	1.66	——	1.53	.92
Other hardwoods	.13	.11	.21	- -	1.25	- -	1.02	.52
All live species	4.72	6.30	4.37	- -	3.72	- -	7.02	5.22
Dead chestnut	- -	- -	- -	- -	- -	- -	-	
All conditions:								
Loblolly and shortleaf pines	13.43	9.53	2.50	- -	1.13	- -	1.11	7.62
Virginia pine	.29	.16	4.72	- -	.02	- -	.21	.60
Other softwoods	.03	.11	.01	- -	1.21	- -	.02	.21
Oaks	1.43	2.20	1.99	——	1.46	- -	5.01	2.33
Gums and yellowpoplar	1.69	1.08	1.11	- -	8.47	- -	3.42	3.06
Other hardwoods	.47	.36	.57	- -	4.02	- -	2.51	1.49
All live species	17.34	13.44	10.90	- -	16.31	- -	12.28	15.31
Dead chestnut	- -	- -	- -	- -	- -	- -	- -	- -

Table 11. - Net cubic-foot volume of all sound material in the Virginia Coastal Plain by species and sources of material, 1940

Species	Saw-timber trees: Sawlogs	Saw-timber trees: Upper stems	Cord-wood	Cull trees	All material
	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Softwoods:					
Loblolly pine	1,174.5	245.8	454.7	43.8	1,918.8
Shortleaf pine	81.1	19.4	71.9	3.1	175.5
Virginia pine	62.3	22.1	71.8	14.9	171.1
White pine	- -	- -	- -	- -	- -
Hemlock	- -	- -	- -	- -	- -
Redcedar	1.9	- -	3.6	.2	5.7
White-cedar	12.0	.9	.4	- -	13.3
Cypress	37.1	9.0	7.1	6.7	59.9
Total	1,368.9	297.2	609.5	68.7	2,344.3
Hardwoods:					
Red maple	41.0	21.3	55.1	84.2	201.6
Blackgum	121.5	59.5	113.4	111.4	405.8
Sweetgum	127.8	66.6	217.3	63.1	474.8
Yellowpoplar	86.6	42.7	100.2	18.9	248.4
Northern red oak	25.8	13.6	16.3	4.0	59.7
Other red oaks	82.0	40.9	154.1	35.4	312.4
White oak	67.4	33.1	182.7	36.8	320.0
Chestnut oak	2.9	1.4	2.9	1.8	9.0
Other white oaks	6.6	3.3	26.8	9.1	45.8
Birch	- -	- -	- -	- -	- -
Beech	40.5	22.0	26.0	26.2	114.7
Hickory	28.2	14.1	47.8	8.3	98.4
Cherry-walnut	- -	- -	- -	- -	- -
Sugar maple	- -	- -	- -	- -	- -
Ash	15.1	7.4	26.0	18.4	66.9
Dogwood	- -	- -	30.1	7.4	37.5
Black locust	- -	- -	- -	- -	- -
Other merchantable hardwoods	31.2	16.4	40.7	29.3	117.6
Scrub hardwoods	- -	- -	- -	24.3	24.3
Total	676.6	342.3	1,039.4	478.6	2,536.9
All species	2,045.5	639.5	1,648.9	547.3	4,881.2

Table 12. - Volume of wood processed in the Virginia Coastal Plain by the primary forest-products industries, 1940

Product	Number of plants	Production or consumption					
		Loblolly, shortleaf, & Virginia pines	Other soft-woods	Oaks	Gums, yellow-poplar	Other hard-woods	Total
		M bd. ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd. ft.
Lumber[1]	567	403,400	14,900	26,100	44,800	3,000	492,200
Veneer	7	1,000	100	- -	21,700	300	23,100
		Cords	Cords	Cords	Cords	Cords	Cords
Cooperage	48	81,700	- -	2,600	2,100	- -	86,400
Pulpwood	4	423,700	- -	- -	- -	- -	423,700
Excelsior	19	41,000	- -	- -	- -	- -	41,000
Fuel wood	- -	648,000	- -	359,100	122,200	49,900	1,179,200
Fence posts	- -	800	6,000	7,200	300	6,400	20,700
Misc.[2]	10	200	4,500	- -	- -	1,400	6,100
		M pcs.	M pcs.	M pcs.	M pcs.	M pcs.	M pcs.
Poles, piles	- -	96	- -	1	6	3	106
Hewn ties	- -	7	5	261	2	- -	275

1/Includes the lumber tally equivalent of all material produced in sawmills.

2/Includes 3 handle plants, 3 wood turning plants, 2 shingle mills, 1 box plant, and 1 shuttle block plant.

Table 13. - Volume of wood cut from the sound-tree growing stock (commodity drain) in the Virginia Coastal Plain, 1940

Product and source of material	Virginia pine	Loblolly and shortleaf pines	Other soft-woods	Oaks	Gums, yellow-poplar	Other hard-woods	Total
	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.
Sawlogs:							
Lumber	18,200	311,900	10,300	24,200	34,200	2,000	400,800
Veneer	- -	700	100	- -	15,400	300	16,500
Cooperage	- -	22,200	- -	300	400	- -	22,900
Pulpwood	13,200	62,200	- -	- -	900	- -	76,300
Excelsior	300	6,600	- -	- -	- -	- -	6,900
Fuel wood	6,100	34,900	- -	9,300	2,200	900	53,400
Fence posts	- -	100	900	900	100	100	2,100
Poles, piles	- -	12,500	- -	300	500	200	13,500
Hewn ties	- -	200	- -	12,100	- -	- -	12,300
Misc.	- -	- -	900	- -	- -	300	1,200
Total	37,800	451,300	12,200	47,100	53,700	3,800	605,900
	Cords	Cords	Cords	Cords	Cords	Cords	Cords
All mt'l:[1]							
Lumber	63,800	803,500	24,800	69,600	89,100	5,400	1,056,200
Veneer	- -	1,800	200	- -	39,400	700	42,100
Cooperage	- -	82,800	- -	700	2,000	- -	85,500
Pulpwood	72,500	269,300	- -	- -	7,300	- -	349,100
Excelsior	2,200	36,700	- -	- -	- -	- -	38,900
Fuel wood	38,100	160,700	- -	160,500	38,900	22,500	420,700
Fence posts	200	600	5,700	6,400	200	5,600	18,700
Poles, piles	300	35,300	- -	800	1,400	600	38,400
Hewn ties	- -	900	100	48,200	100	- -	49,300
Misc.	- -	100	5,200	- -	- -	1,100	6,400
Total	177,100	1,391,700	36,000	286,200	178,400	35,900	2,105,300

[1] Includes the sawlog portion of saw-timber trees, the usable volume in the upper stems of softwood saw timber and in small trees from 5.0 inches d.b.h. to saw-timber size.

Table 14. - The effect of growth, mortality, and commodity drain upon the forest growing stock in the Virginia Coastal Plain, 1940

IN BOARD FEET (INT. $\frac{1}{4}$-INCH RULE)

Species and diameter group	Growing stock Jan. 1, 1940	Gross growth	Mortality	Net growth	Commodity drain	Net change	Growing stock Jan. 1, 1941
	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.
Softwoods:							
10-12 inches	3,300.6	158.9	11.5	147.4	159.8	-12.4	3,288.2
14-18 inches	3,536.2	262.2	10.2	252.0	201.8	50.2	3,586.4
20 and over	1,082.4	115.9	2.4	113.5	139.7	-26.2	1,056.2
Total	7,919.2	537.0	24.1	512.9	501.3	11.6	7,930.8
Hardwoods:							
14-18 inches	2,300.3	160.9	5.5	155.4	53.1	102.3	2,402.6
20 and over	1,528.5	87.6	7.3	80.3	51.5	28.8	1,557.3
Total	3,828.8	248.5	12.8	235.7	104.6	131.1	3,959.9
All species	11,748.0	785.5	36.9	748.6	605.9	142.7	11,890.7

IN CUBIC FEET

	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Softwoods:							
6-8 inches	609.5	25.9	5.1	20.8	12.5	8.3	617.8
10-12 inches	803.8	36.5	2.8	33.7	38.9	-5.2	798.6
14-18 inches	671.0	53.4	1.9	51.5	38.1	13.4	684.4
20 and over	182.4	20.1	0.4	19.7	23.1	-3.4	179.0
Total	2,266.7	135.9	10.2	125.7	112.6	13.1	2,279.8
Hardwoods:							
6-12 inches	1,036.6	44.7	2.6	42.1	13.8	28.3	1,064.9
14-18 inches	425.6	28.5	1.1	27.4	9.8	17.6	443.2
20 and over	253.8	14.6	1.2	13.4	8.5	4.9	258.7
Total	1,716.0	87.8	4.9	82.9	32.1	50.8	1,766.8
All species	3,982.7	223.7	15.1	208.6	144.7	63.9	4,046.6

Table 1. - Land use in the Virginia Piedmont, 1940

Land use	Land area	
	Acres	Per cent
Forest:		
Commercial	5,827,900	57.9
Public reserved	104,300	1.0
Non-commercial	- -	--
Total	5,932,200	58.9
Non-forest:		
Crop-land	2,621,300	26.0
Abandoned crop-land	220,400	2.2
Pasture	1,064,700	10.6
Marsh	14,200	0.2
Other	213,700	2.1
Total	4,134,300	41.1
All uses	10,066,500	100.0

Table 2. - Forest area of the Virginia Piedmont by forest types and conditions, 1940

Forest type	Forest condition			Total	
	Saw timber	Cordwood	Reproduction		
	Acres	Acres	Acres	Acres	Percent
Softwoods:					
Loblolly pine	49,500	31,600	15,300	96,400	1.6
Shortleaf pine[1]	681,600	480,700	70,800	1,233,100	21.2
Virginia pine	474,500	731,200	185,800	1,391,500	23.9
White pine	27,200	8,800	- -	36,000	0.6
Total	1,232,800	1,252,300	271,900	2,757,000	47.3
Hardwoods:					
Bottomland hardwood	192,500	129,600	12,000	334,100	5.7
Cove hardwood	95,700	54,000	- -	149,700	2.6
Upland hardwood	1,189,700	1,272,100	125,300	2,587,100	44.4
Total	1,477,900	1,455,700	137,300	3,070,900	52.7
All types	2,710,700	2,708,000	409,200	5,827,900	100.0

[1] Includes redcedar, 16,500 acres.

Table 3. - Species composition of forest types in the Virginia Piedmont, expressed in percent of net cubic volume, 1940

Species	Forest type							All types
	Loblolly pine	Shortleaf pine	Virginia pine	White pine	Bottomland hardwood	Cove hardwood	Upland hardwood	
Softwoods:								
Pond pine	- -	- -	- -	- -	- -	- -	- -	- -
Loblolly pine	64.4	0.8	0.2	- -	0.6	- -	0.2	1.6
Shortleaf pine	8.5	63.5	9.7	6.9	2.3	0.4	3.7	19.0
Virginia pine	0.8	7.3	60.9	7.0	1.0	1.0	2.2	14.4
White pine	- -	0.1	0.4	43.0	0.1	0.3	0.4	0.7
Hemlock	- -	- -	negl.	1.6	- -	1.7	- -	- -
Redcedar	0.1	0.7	0.4	negl.	0.2	0.1	0.2	0.3
White-cedar	- -	- -	- -	- -	- -	- -	- -	- -
Cypress	- -	- -	- -	- -	- -	- -	- -	- -
Hardwoods:								
Red maple	1.0	0.9	0.9	2.0	7.4	2.4	2.5	2.1
Blackgum	1.0	0.6	0.8	3.0	1.2	1.7	2.6	1.6
Sweetgum	9.4	3.5	1.6	0.2	16.4	0.3	2.7	3.7
Yellowpoplar	4.5	5.7	7.2	4.2	15.1	53.3	11.6	11.2
Northern red oak	0.1	0.9	0.7	0.1	2.1	7.8	6.5	3.7
Other red oaks	3.2	6.1	6.1	12.1	5.7	3.7	16.3	10.3
White oak	3.3	4.7	5.3	9.3	3.8	4.5	24.3	13.2
Chestnut oak	- -	0.6	0.5	3.3	0.1	4.5	11.1	5.2
Other white oaks	0.8	1.2	1.4	2.5	0.7	0.1	1.9	1.4
Birch	- -	- -	- -	- -	- -	- -	- -	- -
Beech	0.1	0.1	0.1	- -	0.9	0.7	1.5	0.8
Hickory	0.5	1.3	1.3	0.5	1.3	4.2	7.4	4.0
Cherry-walnut	- -	- -	- -	- -	- -	- -	- -	- -
Sugar maple	- -	- -	- -	- -	- -	0.1	negl.	negl.
Ash	0.2	0.2	0.2	- -	8.1	2.3	0.6	1.1
Dogwood	0.1	0.5	0.8	0.5	1.0	2.7	1.2	1.0
Black locust	- -	- -	- -	- -	- -	- -	- -	- -
Other hardwoods	1.8	0.9	0.9	1.2	31.2	6.9	2.1	3.9
Scrub hardwoods	0.2	0.4	0.6	2.6	0.8	1.3	1.0	0.8
All species	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4. - Net board-foot volume (Int. $\frac{1}{4}$-inch rule) in the Virginia Piedmont, by species and forest conditions, 1940

Species	Forest condition		Total	
	Saw timber	Cordwood[1]		
	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:				
Loblolly pine	215,300	4,700	220,000	2.9
Shortleaf pine	1,645,800	108,100	1,753,900	23.0
Virginia pine	966,700	91,700	1,058,400	13.9
White pine	82,100	3,500	85,600	1.1
Hemlock	11,600	100	11,700	0.2
Redcedar	14,300	5,000	19,300	0.3
White-cedar	- -	- -	- -	- -
Cypress	- -	- -	- -	- -
Total	2,935,800	213,100	3,148,900	41.4
Hardwoods:				
Red maple	101,000	7,400	108,400	1.4
Blackgum	74,400	4,400	78,800	1.0
Sweetgum	233,400	9,900	243,300	3.2
Yellowpoplar	963,900	38,300	1,002,200	13.2
Northern red oak	430,700	7,000	437,700	5.8
Other red oaks	649,600	36,900	686,500	9.0
White oak	805,800	37,500	843,300	11.1
Chestnut oak	333,800	19,400	353,200	4.6
Other white oaks	60,200	5,000	65,200	0.9
Birch	- -	- -	- -	- -
Beech	58,700	3,400	62,100	0.8
Hickory	239,100	15,500	254,600	3.3
Cherry-walnut	- -	- -	- -	- -
Sugar maple	- -	- -	- -	- -
Ash	51,700	3,000	54,700	0.7
Other hardwoods	259,200	12,300	271,500	3.6
Total	4,261,500	200,000	4,461,500	58.6
All live species	7,197,300	413,100	7,610,400	100.0
Dead chestnut	- -	- -	-	- -
All species	7,197,300	413,100	7,610,400	-

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[1] Includes the saw-timber volume, [illegible] M [illegible] in the reproduction condition.

Table 5. - Net board-foot volume (Int. $\frac{1}{4}$-inch rule) in the Virginia Piedmont by species and diameter classes, 1940

Species	Diameter-class (inches)			Total	
	10-12	14-18	20+		
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:					
Loblolly pine	108,500	94,700	16,800	220,000	2.9
Shortleaf pine	1,108,800	548,800	96,300	1,753,900	23.0
Virginia pine	786,500	265,200	6,700	1,058,400	13.9
White pine	25,800	30,200	29,600	85,600	1.1
Hemlock	3,800	4,900	3,000	11,700	0.2
Redcedar	17,900	1,400	- -	19,300	0.3
White-cedar	- -	- -	- -	- -	- -
Cypress	- -	- -	- -	- -	- -
Total	2,051,300	945,200	152,400	3,148,900	41.4
Hardwoods:					
Red maple	- -	76,400	32,000	108,400	1.4
Blackgum	- -	61,500	17,300	78,800	1.0
Sweetgum	- -	183,500	59,800	243,300	3.2
Yellowpoplar	- -	638,200	364,000	1,002,200	13.2
Northern red oak	- -	162,300	275,400	437,700	5.8
Other red oaks	- -	398,700	287,800	686,500	9.0
White oak	- -	454,200	389,100	843,300	11.1
Chestnut oak	- -	182,400	170,800	353,200	4.6
Other white oaks	- -	45,800	19,400	65,200	0.9
Birch	- -	- -	- -	- -	- -
Beech	- -	45,400	16,700	62,100	0.8
Hickory	- -	182,700	71,900	254,600	3.3
Cherry-walnut	- -	- -	- -	- -	- -
Sugar maple	- -	- -	- -	- -	- -
Ash	- -	43,500	11,200	54,700	0.7
Other hardwoods	- -	163,500	108,000	271,500	3.6
Total	- -	2,638,100	1,823,400	4,461,500	58.6
All live species	2,051,300	3,583,300	1,975,800	7,610,400	100.0
Dead chestnut	- -	- -	- -	- -	- -
All species	2,051,300	3,583,300	1,975,800	7,610,400	- -

Table 6. - Net board-foot volume (Int. 1/4-inch rule) per acre in the Virginia Piedmont by forest conditions and types, 1940

Forest condition and species group	Forest type							All types
	Loblolly pine	Shortleaf pine	Virginia pine	White pine	Bottomland hardwood	Cove hardwood	Upland hardwood	
	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.
Sawtimber:								
Loblolly and shortleaf pines	3,490	1,990	330	240	140	20	120	690
Virginia pine	negl.	210	1,540	230	30	40	60	360
Other softwoods	- -	10	30	1,850	10	120	20	40
Oaks	200	210	340	530	420	1,000	1,490	840
Gums and yellowpoplar	350	240	270	120	1,010	2,200	460	470
Other hardwoods	10	60	60	30	1,310	450	290	260
All live species	4,050	2,720	2,570	3,000	2,920	3,830	2,440	2,660
Dead chestnut	- -	- -	- -	- -	- -	- -	- -	- -
Cordwood:								
Loblolly and shortleaf pines	70	100	20	100	20	negl.	30	40
Virginia pine	- -	20	70	- -	10	20	10	30
Other softwoods	negl.	negl.	negl.	140	negl.	negl.	negl.	negl.
Oaks	negl.	10	10	20	20	60	60	30
Gums and yellowpoplar	10	negl.	10	- -	50	120	20	20
Other hardwoods	- -	10	negl.	- -	50	60	20	10
All live species	80	140	110	260	150	260	140	130
Dead chestnut	- -	- -	- -	- -	- -	- -	- -	- -
All conditions:								
Loblolly and shortleaf pines	1,820	1,140	130	200	90	10	70	340
Virginia pine	negl.	130	570	170	20	30	10	180
Other softwoods	negl.	10	10	1,430	10	80	10	20
Oaks	110	120	120	410	250	660	720	410
Gums and yellowpoplar	190	140	100	90	600	1,450	220	230
Other hardwoods	negl.	30	20	30	780	310	140	130
All live species	2,120	1,570	950	2,330	1,750	2,540	[illegible]	1,310
Dead chestnut	- -	- -	- -	- -	- -	- -	- -	- -

Table 7. - Distribution of saw-timber area and volume (Int. $\frac{1}{4}$-inch rule) in the Virginia Piedmont by volume-per-acre classes and type groups, 1940

Volume-per-acre class (board feet)	Saw-timber area		Saw-timber volume	
	Acres	Percent	M bd. ft.	Percent
Softwood types:				
Less than 2,000	593,100	48.1	709,300	21.1
2,000-3,999	388,100	31.5	1,091,400	32.5
4,000-5,999	158,800	12.9	774,600	23.0
6,000-7,999	54,000	4.4	368,600	11.0
8,000-9,999	22,600	1.8	203,700	6.1
10,000 and over	16,200	1.3	211,500	6.3
Total	1,232,800	100.0	3,359,100	100.0
Hardwood types:				
Less than 2,000	784,800	53.1	928,100	24.2
2,000-3,999	425,900	28.8	1,203,900	31.3
4,000-5,999	167,000	11.3	820,600	21.4
6,000-7,999	50,400	3.4	346,000	9.0
8,000-9,999	22,500	1.5	198,900	5.2
10,000 and over	27,300	1.9	340,700	8.9
Total	1,477,900	100.0	3,838,200	100.0

Table 8. - Net cordwood volume in the Virginia Piedmont by species and sources of material, 1940

Species	Saw-timber trees		Cord-wood	Cull trees	All material
	Sawlogs	Upper stems			
	M cords	M cords	M cords	M cords	M cords
Softwoods:					
Loblolly pine	558.7	132.6	321.7	11.3	1,024.3
Shortleaf pine	5,253.8	1,507.7	5,424.1	274.7	12,460.3
Virginia pine	2,702.2	872.3	4,342.3	978.8	8,895.6
White pine	185.1	44.1	115.8	28.5	373.5
Hemlock	32.5	9.5	9.6	4.7	56.3
Redcedar	46.5	- -	144.2	0.9	191.6
White-cedar	- -	- -	- -	- -	- -
Cypress	- -	- -	- -	- -	- -
Total	8,778.8	2,566.2	10,357.7	1,298.9	23,001.6
Hardwoods:					
Red maple	298.5	171.6	899.8	821.5	2,191.4
Blackgum	232.9	125.7	736.2	345.1	1,439.9
Sweetgum	590.5	351.9	1,538.7	169.1	2,650.2
Yellowpoplar	2,707.4	1,470.3	3,485.7	573.7	8,237.1
Northern red oak	1,055.0	663.0	695.6	319.1	2,732.7
Other red oaks	1,987.2	1,078.3	3,933.4	712.0	7,710.9
White oak	2,381.2	1,341.2	5,073.4	757.8	9,553.6
Chestnut oak	1,112.7	573.5	2,093.5	966.7	4,746.4
Other white oaks	215.8	108.1	730.6	254.9	1,309.4
Birch	- -	- -	- -	- -	- -
Beech	174.2	103.6	212.4	169.5	659.7
Hickory	823.6	434.4	1,618.1	245.9	3,122.0
Cherry-walnut	- -	- -	- -	- -	- -
Sugar maple	- -	- -	4.4	8.0	12.4
Ash	151.7	80.5	490.3	227.8	950.3
Dogwood	- -	- -	642.1	145.0	787.1
Black locust	- -	- -	- -	- -	- -
Other merchantable hardwoods	724.0	429.1	1,281.9	621.0	3,056.0
Scrub hardwoods	- -	- -	- -	516.3	516.3
Total	12,454.7	6,931.2	23,436.1	6,853.4	49,675.4
All live species	21,233.5	9,497.4	33,793.8	8,152.3	72,677.0
Dead chestnut	- -	- -	716.6	2,181.9	2,898.5
All species	21,233.5	9,497.4	34,510.4	10,334.2	75,575.5

Table 9. - Net cordwood volume in the Virginia Piedmont by species and diameter classes, 1940[1]

Species	Diameter class (inches)				Total	
	6-8	10-12	14-18	20+		
	M cords	M cords	M cords	M cords	M cords	Percent
Softwoods:						
Loblolly pine	321.7	397.1	255.2	39.0	1,013.0	1.8
Shortleaf pine	5,424.1	4,881.9	1,645.7	233.9	12,185.6	21.2
Virginia pine	4,342.3	2,822.0	736.2	16.3	7,916.8	13.7
White pine	115.8	82.7	81.5	65.0	345.0	0.6
Hemlock	9.6	16.9	16.5	8.6	51.6	0.1
Redcedar	144.2	43.3	3.2	- -	190.7	0.3
White-cedar	- -	- -	- -	- -	- -	- -
Cypress	- -	- -	- -	- -	- -	- -
Total	10,357.7	8,243.9	2,738.3	362.8	21,702.7	37.7
Hardwoods:						
Red maple	441.7	458.1	218.5	80.0	1,198.3	2.1
Blackgum	337.8	398.4	186.9	46.0	969.1	1.7
Sweetgum	731.4	807.3	458.7	131.8	2,129.2	3.7
Yellowpoplar	1,624.7	1,861.0	1,791.4	916.0	6,193.1	10.8
Northern red oak	313.9	381.7	443.8	611.2	1,750.6	3.0
Other red oaks	1,817.4	2,116.0	1,233.5	753.7	5,920.6	10.3
White oak	2,184.6	2,888.8	1,386.5	994.7	7,454.6	12.9
Chestnut oak	930.9	1,162.6	622.5	490.2	3,206.2	5.6
Other white oaks	312.4	418.2	159.6	56.2	946.4	1.6
Birch	- -	- -	- -	- -	- -	- -
Beech	86.9	125.5	131.3	42.9	386.6	0.7
Hickory	682.6	935.5	630.9	192.7	2,441.7	4.2
Cherry-walnut	- -	- -	- -	- -	- -	- -
Sugar maple	1.7	2.7	- -	- -	4.4	negl.
Ash	255.0	235.3	123.4	28.3	642.0	1.1
Dogwood	393.6	183.6	59.5	5.4	642.1	1.1
Black locust	- -	- -	- -	- -	- -	- -
Other merch. hdwds.	563.1	718.8	458.7	265.3	2,005.9	3.5
Total	10,677.7	12,693.5	7,905.2	4,614.4	35,890.8	62.3
All live species	21,035.4	20,937.4	10,643.5	4,977.2	57,593.5	100.0
Dead chestnut	248.9	467.7	817.2	1,364.7	2,898.5	- -
All species	21,284.3	21,405.1	11,460.7	6,341.9	60,492.0	- -

[1] This table differs from table 8 in that the volume contained in cull trees and upper stems and limbs of saw-timber-size hardwoods is not included.

Table 10. - Cordwood volume per acre in the Virginia Piedmont, by forest conditions and types, 1940

Forest condition and species group	Forest type							All types
	Loblolly pine	Shortleaf pine	Virginia pine	White pine	Bottomland hardwood	Cove hardwood	Upland hardwood	
	Cords	Cords	Cords	Cords	Cords	Cords	Cords	Cords
Saw timber:								
Loblolly and shortleaf pines	15.95	12.07	1.91	1.02	.59	.10	.56	3.96
Virginia pine	.13	1.10	8.97	1.06	.15	.14	.30	2.01
Other softwoods	.01	.11	.13	6.99	.04	.51	.08	.17
Oaks	1.59	2.24	2.37	4.24	2.17	3.86	8.17	4.93
Gums and yellowpoplar	3.31	1.63	1.60	1.12	5.85	10.79	2.56	2.68
Other hardwoods	.81	.63	.69	.68	8.17	3.74	2.30	2.02
All live species	21.80	17.78	15.67	15.11	16.97	19.14	13.97	15.77
Dead chestnut	- -	.06	.09	1.31	.13	1.24	1.22	.63
Cordwood:								
Loblolly and shortleaf pines	2.39	2.95	.32	.76	.15	.03	.28	.79
Virginia pine	.04	.38	2.27	.26	.08	.17	.12	.79
Other softwoods	.02	.05	.02	1.68	.02	.03	.03	.04
Oaks	.10	.79	.45	1.58	.49	1.05	3.53	1.90
Gums and yellowpoplar	.20	.44	.28	.66	1.55	4.60	.74	.65
Other hardwoods	.13	.21	.17	.23	2.64	1.83	.78	.59
All live species	2.88	4.82	3.51	5.17	4.93	7.71	5.48	4.76
Dead chestnut	- -	.02	.16	1.14	- -	.78	.70	.38
All conditions:								
Loblolly and shortleaf pines	9.35	7.99	.86	.96	.40	.08	.41	2.26
Virginia pine	.09	.78	4.56	.86	.12	.15	.20	1.36
Other softwoods	.02	.08	.06	5.69	.03	.34	.05	.10
Oaks	.86	1.59	1.10	3.59	1.46	2.85	5.67	3.31
Gums and yellowpoplar	1.79	1.10	.73	1.01	4.03	8.55	1.58	1.59
Other hardwoods	.48	.44	.35	.57	5.83	3.05	1.48	1.26
All live species	12.59	11.98	7.66	12.68	11.87	15.02	9.39	9.88
Dead chestnut	- -	.04	.14	1.27	.07	1.07	.94	.50

Table 11. - Net cubic-foot volume of all sound material in the Virginia Piedmont by species and sources of material, 1940

Species	Saw-timber trees		Cord-wood	Cull trees	All material
	Sawlogs	Upper stems			
	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Softwoods:					
Loblolly pine	38.9	9.1	20.9	0.8	69.7
Shortleaf pine	353.0	103.3	342.1	18.0	816.4
Virginia pine	214.8	59.5	329.4	74.2	677.9
White pine	13.8	3.1	8.7	2.1	27.7
Hemlock	2.5	0.7	0.6	0.3	4.1
Redcedar	3.7	- -	10.7	negl.	14.4
White-cedar	- -	- -	- -	- -	- -
Cypress	- -	- -	- -	- -	- -
Total	626.7	175.7	712.4	95.4	1,610.2
Hardwoods:					
Red maple	20.2	10.5	59.2	54.6	144.5
Blackgum	15.4	7.2	45.9	21.9	90.4
Sweetgum	40.0	21.0	94.5	10.5	166.0
Yellowpoplar	171.5	80.7	217.5	36.6	506.3
Northern red oak	72.2	39.6	41.3	21.2	174.3
Other red oaks	128.6	60.4	246.1	45.1	480.2
White oak	155.3	76.2	323.1	48.1	602.7
Chestnut oak	69.5	31.1	118.4	58.2	277.2
Other white oaks	13.3	5.6	41.3	14.9	75.1
Birch	- -	- -	- -	- -	- -
Beech	12.3	6.3	14.8	11.5	44.9
Hickory	51.3	23.2	94.0	14.8	183.3
Cherry-walnut	- -	- -	- -	- -	- -
Sugar maple	- -	- -	0.3	0.5	0.8
Ash	9.6	4.3	30.7	14.4	59.0
Dogwood	- -	- -	41.7	9.4	51.1
Black locust	- -	- -	- -	- -	- -
Other merchantable hardwoods	50.6	26.2	88.8	41.8	207.4
Scrub hardwoods	- -	- -	- -	33.2	33.2
Total	809.8	392.3	1,457.6	436.7	3,096.4
All species	1,436.5	568.0	2,170.0	532.1	4,706.6

Table 12. - Volume of wood processed in the Virginia Piedmont by the primary forest-products industries, 1940

Product	Number of plants	Production or consumption					
		Loblolly, shortleaf, & Virginia pines	Other soft-woods	Oaks	Gums, yellow-poplar	Other hard-woods	Total
		M bd. ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd. ft.
Lumber[1]	1,196	264,600	3,200	60,100	52,000	2.900	382,800
Veneer	3	- -	- -	300	7,200	900	8,400
		Cords	Cords	Cords	Cords	Cords	Cords
Cooperage	17	16,500	- -	400	800	- -	17,700
Mine timbers	- -	200	- -	400	- -	300	900
Fuel wood	- -	616,100	- -	713,800	159,300	185,600	1,674,800
Fence posts	- -	400	18,400	10,300	- -	28,000	57,100
Misc.[2]	15	18,000	12,500	1,200	400	53,000	85,100
		M pcs.	M pcs.	M pcs.	M pcs.	M pcs.	M pcs.
Poles, piles	- -	22	- -	- -	- -	- -	22
Hewn ties	- -	- -	- -	207	- -	- -	207

[1] Includes lumber tally equivalent of all material produced in sawmills.

[2] Includes 2 pulp mills, 5 handle plants, 1 excelsior plant, 2 insulator pin plants, 1 dimension stock plant, 1 picker stick plant, 1 plant making wooden utensils (spoons, forks, etc.), 1 plant making cedar chests, and 1 wood turning plant.

Table 13. - Volume of wood cut from the sound-tree growing stock (commodity drain) in the Virginia Piedmont, 1940

Product and source of material	Virginia pine	Loblolly and shortleaf pines	Other soft-woods	Oaks	Gums, yellow-poplar	Other hard-woods	Total
	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.
Sawlogs:							
Lumber	61,500	185,400	3,200	58,700	49,300	2,700	360,800
Veneer	- -	- -	- -	200	7,600	1,700	9,500
Cooperage	300	3,300	- -	100	100	- -	3,800
Pulpwood	11,500	24,100	- -	- -	2,700	200	38,500
Excelsior	- -	300	- -	- -	- -	- -	300
Mine timbers	- -	100	- -	- -	- -	- -	100
Fuel wood	12,700	14,000	- -	7,300	1,600	1,600	37,200
Fence posts	100	- -	2,600	1,400	- -	400	4,500
Poles, piles	- -	2,300	- -	- -	- -	100	2,400
Hewn ties	- -	- -	- -	9,900	- -	- -	9,900
Misc.	- -	- -	300	400	100	700	1,500
Total	86,100	229,500	6,100	78,000	61,400	7,400	468,500
	Cords	Cords	Cords	Cords	Cords	Cords	Cords
All mt'l:1/							
Lumber	197,700	637,100	8,200	183,500	148,800	8,500	1,183,800
Veneer	- -	- -	- -	700	19,800	4,600	25,100
Cooperage	1,300	13,200	- -	400	1,200	- -	16,100
Pulpwood	61,900	137,900	- -	400	25,900	1,400	227,500
Excelsior	100	2,200	- -	- -	- -	- -	2,300
Mine timbers	- -	200	- -	400	- -	300	900
Fuel wood	123,300	99,900	- -	209,200	49,500	61,400	543,300
Fence posts	300	100	17,700	9,600	- -	24,500	52,200
Poles, piles	- -	8,700	- -	- -	- -	300	9,000
Hewn ties	- -	- -	- -	36,300	- -	- -	36,300
Misc.	- -	- -	1,400	1,200	100	2,800	5,500
Total	384,600	899,300	27,300	441,700	245,300	103,800	2,102,000

1/Includes the sawlog portion of saw-timber trees, the usable volume in the upper stems of softwood saw-timber and in small trees from 5.0 inches d.b.h. to saw-timber size.

Table 14. - The effect of growth, mortality, and commodity drain upon the forest growing stock in the Virginia Piedmont, 1940

IN BOARD FEET (INT. $\frac{1}{4}$-INCH RULE)

Species and diameter group	Growing stock Jan. 1, 1940	Gross growth	Mortality	Net growth	Commodity drain	Net change	Growing stock Jan. 1, 1941
	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.
Softwoods:							
10-12 inches	2,033.9	174.3	7.8	166.5	154.4	12.1	2,046.0
14-18 inches	948.3	120.4	6.2	114.2	137.2	-23.0	925.3
20 and over	152.2	14.3	2.1	12.2	30.1	-17.9	134.3
Total	3,134.4	309.0	16.1	292.9	321.7	-28.8	3,105.6
Hardwoods:							
14-18 inches	2,576.7	223.7	5.5	218.2	88.5	129.7	2,706.4
20 and over	1,787.9	117.0	3.6	113.4	58.3	55.1	1,843.0
Total	4,364.6	340.7	9.1	331.6	146.8	184.8	4,549.4
All species	7,499.0	649.7	25.2	624.5	468.5	156.0	7,655.0

IN CUBIC FEET

Species and diameter group	Growing stock Jan. 1, 1940	Gross growth	Mortality	Net growth	Commodity drain	Net change	Growing stock Jan. 1, 1941
	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Softwoods:							
6-8 inches	702.2	42.4	4.6	37.8	16.8	21.0	723.2
10-12 inches	570.4	47.2	2.2	45.0	41.8	3.2	573.6
14-18 inches	200.3	27.8	1.3	26.5	28.9	-2.4	197.9
20 and over	27.4	2.8	0.3	2.5	5.6	-3.1	24.3
Total	1,500.3	120.2	8.4	111.8	93.1	18.7	1,519.0
Hardwoods:							
6-12 inches	1,435.1	60.7	3.6	57.1	24.0	33.1	1,468.2
14-18 inches	496.6	41.9	1.0	40.9	16.7	24.2	520.8
20 and over	301.6	19.5	0.8	18.7	10.3	8.4	310.0
Total	2,233.3	122.1	5.4	116.7	51.0	65.7	2,299.0
All species	3,733.6	242.3	13.8	228.5	144.1	84.4	3,818.0

Table 1. - Land use in the Virginia
Mountains, 1940

Land use	Land area	
	Acres	Percent
Forest:		
Commercial	4,664,900	51.2
Public reserved	107,000	1.2
Non-commercial	184,400	2.0
Total	4,956,300	54.4
Non-forest:		
Crop-land	1,649,000	18.1
Abandoned crop-land	77,600	0.9
Pasture	2,209,100	24.2
Marsh	- -	---
Other	214,000	2.4
Total	4,149,700	45.6
All uses	9,106,000	100.0

Table 2. - Forest area of the Virginia Mountains by forest types and conditions, 1940

Forest type	Forest condition			Total	
	Saw timber	Cord-wood	Repro-duction		
	Acres	Acres	Acres	Acres	Percent
Softwoods:					
Loblolly pine	- -	- -	- -	- -	- -
Shortleaf pine[1]	234,800	324,500	14,600	573,900	12.3
Virginia pine	71,500	174,500	39,100	285,100	6.1
White pine[2]	138,700	59,800	1,600	200,100	4.3
Total	445,000	558,800	55.300	1,059,100	22.7
Hardwoods:					
Bottomland hardwood[3]	8,100	17,000	800	25,900	0.5
Cove hardwood[4]	221,100	184,400	3,300	408,800	8.8
Upland hardwood	1,292,800	1,808,800	69,500	3,171,100	68.0
Total	1,522,000	2,010,200	73,600	3,605,800	77.3
All types	1,967,000	2,569,000	128,900	4,664,900	100.0

1/Includes redcedar, 45,100 acres.

2/Includes hemlock, 74,400 acres.

3/Stream margin hardwoods only.

4/Includes northern hardwoods, 128,400 acres.

Table 3. - Species distribution of forest types in the Virginia Mountains, expressed in percent of net cubic volume, 1940

Species	Forest type							All types
	Loblolly pine	Shortleaf pine	Virginia pine	White pine	Bottomland hardwood	Cove hardwood	Upland hardwood	
Softwoods:								
Pond pine	- -	- -	- -	- -	- -	- -	- -	- -
Loblolly pine	- -	- -	- -	- -	- -	- -	- -	- -
Shortleaf pine	- -	65.9	6.9	2.2	- -	0.1	3.2	8.4
Virginia pine	- -	3.1	55.0	0.8	1.0	0.2	0.9	3.6
White pine	- -	2.5	4.0	29.6	2.5	0.7	1.4	3.8
Hemlock	- -	0.3	0.1	25.8	1.8	1.5	0.4	2.5
Redcedar	- -	2.3	0.6	0.2	0.9	0.2	0.1	0.4
White-cedar	- -	- -	- -	- -	- -	- -	- -	- -
Cypress	- -	- -	- -	- -	- -	- -	- -	- -
Hardwoods:								
Red maple	- -	0.1	0.3	1.9	7.5	3.7	2.0	2.0
Blackgum	- -	0.2	0.2	0.4	0.8	1.4	2.4	1.8
Sweetgum	- -	- -	- -	- -	- -	- -	- -	- -
Yellowpoplar	- -	1.4	1.5	2.9	26.9	22.9	4.7	6.6
Northern red oak	- -	0.8	0.9	3.1	7.7	12.4	8.7	7.6
Other red oaks	- -	7.5	10.5	6.9	3.6	2.4	18.3	14.0
White oak	- -	4.3	0.5	7.8	- -	- -	0.2	0.2
Chestnut oak	- -	7.4	4.7	5.0	2.2	3.8	22.9	16.7
Other white oaks	- -	0.4	10.0	negl.	4.6	4.2	15.4	12.1
Birch	- -	negl.	negl.	1.7	0.6	4.5	0.6	1.1
Beech	- -	- -	- -	- -	- -	- -	- -	- -
Hickory	- -	0.9	2.0	2.0	- -	5.3	8.5	6.6
Cherry-walnut	- -	0.2	0.1	0.2	6.5	2.1	1.1	1.0
Sugar maple	- -	0.1	negl.	2.0	3.1	6.7	1.0	1.7
Ash	- -	0.2	0.2	0.3	1.0	2.3	0.6	0.7
Dogwood	- -	negl.	0.2	negl.	0.4	0.2	0.1	0.1
Black locust	- -	1.0	1.2	0.7	2.4	3.1	3.2	2.7
Other hardwoods	- -	0.6	0.7	5.7	25.3	20.8	3.1	5.3
Scrub hardwoods	- -	0.8	0.4	0.8	1.2	1.5	1.2	1.1
All species	- -	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4. - Net board-foot volume (Int. $\frac{1}{4}$-inch rule) in the Virginia Mountains by species and forest conditions, 1940

Species	Forest condition		Total	
	Saw timber	Cordwood[1]		
	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:				
Loblolly pine	- -	- -	- -	- -
Shortleaf pine	413,600	96,000	509,600	10.3
Virginia pine	101,600	29,000	130,600	2.6
White pine	301,800	26,500	328,300	6.6
Hemlock[2]	228,500	11,500	240,000	4.8
Redcedar	8,300	3,100	11,400	0.2
White-cedar	- -	- -	- -	- -
Cypress	- -	- -	- -	- -
Total	1,053,800	166,100	1,219,900	24.5
Hardwoods:				
Red maple	58,300	4,200	62,500	1.3
Blackgum	109,200	11,400	120,600	2.4
Sweetgum	- -	- -	- -	- -
Yellowpoplar	326,500	21,500	348,000	7.0
Northern red oak	450,300	23,900	474,200	9.5
Other red oaks	498,900	43,100	542,000	10.9
White oak	674,500	21,800	696,300	14.0
Chestnut oak	760,200	44,500	804,700	16.2
Other white oaks	6,300	1,100	7,400	0.1
Birch	34,500	2,800	37,300	0.7
Beech	- -	- -	- -	- -
Hickory	220,900	15,200	236,100	4.8
Cherry-walnut	42,400	7,800	50,200	1.0
Sugar maple	92,400	4,100	96,500	1.9
Ash	27,800	1,900	29,700	0.6
Other hardwoods[3]	236,400	14,000	250,400	5.1
Total	3,538,600	217,300	3,755,900	75.5
All live species	4,592,400	383,400	4,975,800	100.0
Dead chestnut	444,400	314,000	758,400	- -
All species	5,036,800	697,400	5,734,200	- -

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[1] Includes the saw-timber volume, 1,400 M board feet in the reproduction condition.

[2] Includes red spruce, 2,700 M board feet.

[3] Includes basswood, 68,100 M board feet.

Table 5. - Net board-foot volume (Int. ¼-inch rule) in the Virginia Mountains by species and diameter classes, 1940

Species	Diameter-class (inches)			Total	
	10-12	14-18	20 +		
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:					
Loblolly pine	- -	- -	- -	- -	- -
Shortleaf pine	256,700	200,400	52,500	509,600	10.3
Virginia pine	104,300	26,300	- -	130,600	2.6
White pine	92,100	131,500	104,700	328,300	6.6
Hemlock	31,400	76,200	132,400	240,000	4.8
Redcedar	7,900	3,500	- -	11,400	0.2
White-cedar	- -	- -	- -	- -	- -
Cypress	- -	- -	- -	- -	- -
Total	492,400	437,900	289,600	1,219,900	24.5
Hardwoods:					
Red maple	- -	33,900	28,600	62,500	1.3
Blackgum	- -	77,100	43,500	120,600	2.4
Sweetgum	- -	- -	- -	- -	- -
Yellowpoplar	- -	195,600	152,400	348,000	7.0
Northern red oak	- -	207,700	266,500	474,200	9.5
Other red oaks	- -	364,400	177,600	542,000	10.9
White oak	- -	292,400	403,900	696,300	14.0
Chestnut oak	- -	386,700	418,000	804,700	16.2
Other white oaks	- -	5,100	2,300	7,400	0.1
Birch	- -	22,800	14,500	37,300	0.7
Beech	- -	- -	- -	- -	- -
Hickory	- -	149,700	86,400	236,100	4.8
Cherry-walnut	- -	31,200	19,000	50,200	1.0
Sugar maple	- -	39,200	57,300	96,500	1.9
Ash	- -	19,200	10,500	29,700	0.6
Other hardwoods	- -	145,900	104,500	250,400	5.1
Total	- -	1,970,900	1,785,000	3,755,900	75.5
All live species	492,400	2,408,800	2,074,600	4,975,800	100.0
Dead chestnut	- -	376,800	381,600	758,400	- -
All species	492,400	2,785,600	2,456,200	5,734,200	- -

Table 6. - Net board foot volume (Int. ¼-inch rule) per acre in the Virginia Mountains by forest conditions and types, 1940

Forest condition and species group	Forest type							All types
	Lob-lolly pine	Short-leaf pine	Vir-ginia pine	White pine	Bottom-land hard-wood	Cove hard-wood	Up-land hard-wood	
	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.
Saw timber:								
Loblolly and shortleaf pines	- -	1,220	190	90	- -	negl.	80	210
Virginia pine	- -	30	1,080	10	40	10	10	50
Other softwoods	- -	90	180	2,760	150	100	80	270
Oaks	- -	200	550	630	480	850	1,560	1,220
Gums and yellowpoplar	- -	50	50	100	1,330	650	200	220
Other hardwoods	- -	10	50	340	800	1.200	300	360
All live species	- -	1,600	2,100	3,930	2.800	2.810	2.230	2.330
Dead chestnut	- -	40	10	140	- -	300	270	230
Cordwood:								
Loblolly and shortleaf pines	-	120	20	30	- -	negl.	20	40
Virginia pine	- -	10	60	10	- -	negl.	10	10
Other softwoods	- -	20	20	220	10	20	10	10
Oaks	- -	10	10	40	40	40	60	50
Gums and yellowpoplar	- -	- -	negl.	- -	- -	60	10	10
Other hardwoods	- -	negl.	negl.	20	80	70	20	20
All live species	- -	160	110	320	130	190	130	140
Dead chestnut	- -	20	10	70	- -	[illegible]	140	120
All conditions:								
Loblolly and shortleaf pines	- -	570	60	70	- -	negl.	[illegible]	110
Virginia pine	- -	10	320	10	10	10	10	30
Other softwoods	- -	50	60	1,980	50	[illegible]	40	130
Oaks	- -	90	150	450	180	470	670	540
Gums and yellowpoplar	- -	20	10	70	420	380	90	100
Other hardwoods	- -	10	10	240	310	680	130	160
All live species	- -	750	610	2,820	970	1,610	[illegible]	1,070
Dead chestnut	- -	30	10	120	- -	[illegible]	200	160

Table 7. - Distribution of saw-timber area and volume (Int. $\frac{1}{4}$-inch rule) in the Virginia Mountains by volume-per-acre classes and forest types, 1940

Volume-per-acre class (board feet)	Saw-timber area		Saw-timber volume	
	Acres	Percent	M bd. ft.	Percent
Softwood types:				
Less than 2,000	271,300	61.0	295,800	27.6
2,000-3,999	100,300	22.5	274,500	25.6
4,000-5,999	35,100	7.9	164,600	15.4
6,000-7,999	22,000	4.9	153,100	14.3
8,000-9,999	7,300	1.7	64,800	6.0
10,000 and over	9,000	2.0	118,400	11.1
Total	445,000	100.0	1,071,200	100.0
Hardwood types:				
Less than 2,000	918,400	60.3	1,024,700	29.1
2,000-3,999	370,100	24.3	1,042,500	29.6
4,000-5,999	134,700	8.9	646,800	18.4
6,000-7,999	56,400	3.7	385,800	11.0
8,000-9,999	31,000	2.0	275,100	7.8
10,000 and over	11,400	0.8	146,300	4.1
Total	1,522,000	100.0	3,521,200	100.0

Table 8. - Net cordwood volume in the Virginia Mountains by species and sources of material, 1940

Species	Saw-timber trees		Cord-wood	Cull trees	All material
	Sawlogs	Upper stems			
	M cords	M cords	M cords	M cords	M cords
Softwoods:					
Loblolly pine	- -	- -	- -	- -	- -
Shortleaf pine	1,347.3	418.5	907.3	369.5	3,042.6
Virginia pine	357.3	113.6	619.8	190.6	1,281.3
White pine	734.0	163.1	189.1	104.9	1,191.1
Hemlock	537.6	99.9	96.2	83.2	816.9
Redcedar	30.0	- -	70.6	0.9	101.5
White-cedar	- -	- -	- -	- -	- -
Cypress	- -	- -	- -	- -	- -
Total	3,006.2	795.1	1,883.0	749.1	6,433.4
Hardwoods:					
Red maple	175.9	103.4	404.3	596.3	1,279.9
Blackgum	356.6	133.6	153.2	430.4	1,073.8
Sweetgum	- -	- -	- -	- -	- -
Yellowpoplar	896.0	459.7	1,023.4	415.1	2,794.2
Northern red oak	1,224.2	682.7	867.0	838.0	3,611.9
Other red oaks	1,575.8	837.4	2,682.8	1,229.2	6,325.2
White oak	1,804.0	1,025.6	1,458.0	1,097.4	5,385.0
Chestnut oak	2,391.9	1,299.7	2,670.7	4,190.0	10,552.3
Other white oaks	21.9	11.8	53.0	46.8	133.5
Birch	100.6	59.5	218.6	291.1	669.8
Beech	- -	- -	- -	- -	- -
Hickory	709.8	395.8	1,297.0	603.2	3,005.8
Cherry-walnut	129.5	66.2	177.0	83.1	455.8
Sugar maple	259.2	158.5	155.1	307.2	880.0
Ash	76.7	37.3	150.0	115.7	379.7
Dogwood	- -	- -	53.4	28.5	81.9
Black locust	- -	- -	1,096.0	185.0	1,281.0
Other merchantable hardwoods	696.2	359.7	775.2	1,254.9	3,086.0
Scrub hardwoods	- -	- -	- -	464.0	464.0
Total	10,418.3	5,630.9	13,234.7	12,175.9	41,459.8
All live species	13,424.5	6,426.0	15,117.7	12,925.0	47,893.2
Dead chestnut	2,552.5	1,083.0	2,174.4	904.4	6,714.3
All species	15,977.0	7,509.0	17,292.1	13,829.4	54,607.5

Table 9. - Net cordwood volume in the Virginia Mountains by species and diameter classes, 1940[1]

Species	Diameter class (inches)				Total	
	6-8	10-12	14-18	20+		
	M cords	M cords	M cords	M cords	M cords	Percent
Softwoods:						
Loblolly pine	- -	- -	- -	- -	- -	- -
Shortleaf pine	907.3	1,020.1	608.9	136.8	2,673.1	9.1
Virginia pine	619.8	394.0	76.9	- -	1,090.7	3.7
White pine	189.1	309.9	347.0	240.2	1,086.2	3.7
Hemlock	96.2	117.9	208.3	311.3	733.7	2.5
Redcedar	70.6	21.7	8.3	- -	100.6	0.4
White-cedar	- -	- -	- -	- -	- -	- -
Cypress	- -	- -	- -	- -	- -	- -
Total	1,883.0	1,863.6	1,249.4	688.3	5,684.3	19.4
Hardwoods:						
Red maple	237.6	166.7	98.4	77.5	580.2	2.0
Blackgum	52.5	100.7	241.1	115.5	509.8	1.7
Sweetgum	- -	- -	- -	- -	- -	- -
Yellowpoplar	460.4	563.0	533.9	362.1	1,919.4	6.6
Northern red oak	321.7	545.3	583.8	640.4	2,091.2	7.1
Other red oaks	1,247.4	1,435.4	1,110.3	465.5	4,258.6	14.5
White oak	646.5	811.5	804.2	999.8	3,262.0	11.1
Chestnut oak	1,205.3	1,465.4	1,202.8	1,189.1	5,062.6	17.3
Other white oaks	22.6	30.4	15.5	6.4	74.9	0.3
Birch	95.5	123.1	65.9	34.7	319.2	1.1
Beech	- -	- -	- -	- -	- -	- -
Hickory	548.2	748.8	470.0	239.8	2,006.8	6.8
Cherry-walnut	72.0	105.0	84.8	44.7	306.5	1.0
Sugar maple	78.9	76.2	112.2	147.0	414.3	1.4
Ash	74.6	75.4	51.8	24.9	226.7	0.8
Dogwood	45.0	5.6	2.8	- -	53.4	0.2
Black locust	515.5	366.5	166.7	47.3	1,096.0	3.7
Other merch. hdwds.	314.1	461.1	432.5	263.7	1,471.4	5.0
Total	5,937.8	7,080.1	5,976.7	4,658.4	23,653.0	80.6
All live species	7,820.8	8,943.7	7,226.1	5,346.7	29,337.3	100.0
Dead chestnut	794.8	1,379.6	1,678.9	1,778.0	5,631.3	- -
All species	8,615.6	10,323.3	8,905.0	7,124.7	34,968.6	- -

[1] This table differs from table 8 in that the volume contained in cull trees and upper stems and limbs of saw-timber-size hardwoods is not included.

Table 10. - Cordwood volume per acre in the Virginia Mountains, by forest conditions and types, 1940

Forest condition and species group	Forest type							All types
	Lob-lolly pine	Short-leaf pine	Vir-ginia pine	White pine	Bottom-land hard-wood	Cove hard-wood	Up-land hard-wood	
	Cords	Cords	Cords	Cords	Cords	Cords	Cords	Cords
Saw timber:								
Loblolly and shortleaf pines	- -	5.52	.94	.31	- -	.01	.28	.90
Virginia pine	- -	.20	6.18	.10	.16	.02	.06	.30
Other softwoods	- -	.32	.65	8.38	.48	[illegible]	.22	.83
Oaks	- -	1.70	3.66	3.15	1.88	[illegible]	6.66	5.28
Gums and yellowpoplar	- -	.15	.22	.50	3.63	2.81	.78	.90
Other hardwoods	- -	.24	.63	1.98	4.52	6.10	2.14	2.30
All live species	- -	8.13	12.28	14.42	10.67	12.22	10.14	10.51
Dead chestnut	- -	.47	.08	1.11	.14	1.94	1.95	1.64
Cordwood:								
Loblolly and shortleaf pines	- -	1.64	.19	.18	- -	.01	.16	.34
Virginia pine	- -	.11	1.71	.08	- -	.01	.05	.19
Other softwoods	- -	.17	.10	1.61	.17	.08	.05	.10
Oaks	- -	.55	.69	1.29	.42	.68	2.03	1.62
Gums and yellowpoplar	- -	negl.	.05	.13	.05	1.65	.17	.24
Other hardwoods	- -	.11	.16	.88	1.46	2.16	.74	.72
All live species	- -	2.58	2.90	4.17	2.10	4.59	3.20	3.21
Dead chestnut	- -	.23	.04	.68	- -	1.03	1.11	[illegible]
All conditions:								
Loblolly and shortleaf pines	- -	3.23	.38	.27	- -	.01	.21	.58
Virginia pine	- -	.15	2.83	.09	.05	.02	.05	.23
Other softwoods	- -	.23	.23	6.30	.27	.21	.12	.41
Oaks	- -	1.02	1.44	2.58	.87	1.91	3.92	3.16
Gums and yellowpoplar	- -	.06	.09	.39	1.17	2.28	.42	.52
Other hardwoods	- -	.16	.28	1.64	2.42	4.29	1.31	1.39
All live species	- -	4.85	5.25	11.27	4.78	8.72	6.03	6.29
Dead chestnut	- -	.33	.05	.98	.04	1.52	1.45	1.21

Table 11. - Net cubic-foot volume of all sound material in the Virginia Mountains by species and sources of material, 1940

Species	Saw-timber trees		Cord-wood	Cull trees	All material
	Sawlogs	Upper stems			
	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Softwoods:					
Loblolly pine	- -	- -	- -	- -	- -
Shortleaf pine	97.8	29.8	62.8	25.6	216.0
Virginia pine	27.9	7.9	46.2	13.9	95.9
White pine	57.8	12.2	14.5	8.1	92.6
Hemlock	42.6	7.9	7.4	6.6	64.5
Redcedar	2.3	- -	5.7	negl.	8.0
White-cedar	- -	- -	- -	- -	- -
Cypress	- -	- -	- -	- -	- -
Total	228.4	57.8	136.6	54.2	477.0
Hardwoods:					
Red maple	11.9	5.9	26.9	39.2	83.9
Blackgum	22.9	7.8	10.4	29.7	70.8
Sweetgum	- -	- -	- -	- -	- -
Yellowpoplar	57.7	25.9	64.1	27.0	174.7
Northern red oak	80.7	38.9	52.6	53.8	226.0
Other red oaks	102.4	49.4	163.0	76.9	391.7
White oak	120.0	58.1	94.2	71.4	343.7
Chestnut oak	149.3	71.1	156.3	259.5	636.2
Other white oaks	1.4	0.7	3.1	2.8	8.0
Birch	7.0	3.6	14.2	19.6	44.4
Beech	- -	- -	- -	- -	- -
Hickory	46.9	21.4	79.3	37.6	185.2
Cherry-walnut	8.7	3.8	10.8	5.3	28.6
Sugar maple	17.7	9.4	10.3	20.8	58.2
Ash	5.1	2.2	9.1	7.2	23.6
Dogwood	- -	- -	2.9	1.5	4.4
Black locust	- -	- -	61.0	10.1	71.1
Other merchantable hardwoods	47.2	21.9	51.4	82.0	202.5
Scrub hardwoods	- -	- -	- -	25.4	25.4
Total	678.9	320.1	809.6	769.8	2,578.4
All species	907.3	377.9	946.2	824.0	3,055.4

Table 12. - Volume of wood processed in the Virginia Mountains by the primary forest-products industries, 1940

Product	Number of plants	Production or consumption					
		Loblolly, shortleaf, & Virginia pines	Other softwoods	Oaks	Gums, yellow-poplar	Other hardwoods	Total
		M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.
Lumber 1/	999	11,000	26,700	100,800	20,900	38,100	197,500
Veneer	5	- -	500	1,200	2,900	1,000	5,600
		Cords	Cords	Cords	Cords	Cords	Cords
Cooperage	4	- -	- -	2,300	700	100	3,100
Tanning ext.	9	- -	- -	8,400	- -	97,900	106,300
Mine timbers	- -	8,900	1,200	34,800	14,400	41,500	100,800
Fuel wood	- -	100,200	41,100	514,000	85,500	302,300	1,043,100
Fence posts	- -	100	1,800	300	- -	33,300	35,500
Misc. 2/	15	251,200	- -	20,600	62,600	20,900	355,300
		M pcs.	M pcs.	M pcs.	M pcs.	M pcs.	M pcs.
Hewn ties	- -	- -	- -	51	- -	- -	51

1/ Includes lumber tally equivalent of all material produced in sawmills.

2/ Includes 3 pulp mills, 5 handle plants, 1 wood turning plant, 3 insulator pin plants, 1 shingle mill, 1 box plant, and 1 mine wedge plant.

Table 13. - Volume of wood cut from the sound-tree growing stock (commodity drain) in the Virginia Mountains, 1940

Product and source of material	Virginia pine	Loblolly and shortleaf pines	Other soft-woods	Oaks	Gums, yellow-poplar	Other hard-woods	Total
	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.
Sawlogs:							
Lumber	3,100	6,300	25,900	92,000	19,100	22,400	168,800
Veneer	- -	- -	100	700	900	500	2,200
Cooperage	- -	- -	- -	1,300	- -	100	1,400
Pulpwood	4,400	5,900	- -	2,700	2,100	1,700	16,800
Mine timbers	100	1,200	200	2,300	500	2,800	7,100
Fuel wood	800	1,800	- -	5,200	200	1,000	9,000
Fence posts	- -	- -	300	- -	- -	500	800
Hewn ties	- -	- -	- -	2,400	- -	- -	2,400
Misc.	- -	- -	400	200	200	2,200	3,000
Total	8,400	15,200	26,900	106,800	23,000	31,200	211,500
	Cords	Cords	Cords	Cords	Cords	Cords	Cords
All mt'l:1/							
Lumber	10,300	19,900	65,600	271,500	53,800	64,600	485,700
Veneer	- -	- -	200	1,700	2,400	1,400	5,700
Cooperage	- -	- -	- -	3,500	400	100	4,000
Pulpwood	25,500	34,100	- -	17,100	22,300	10,900	109,900
Mine timbers	600	8,200	1,200	34,800	14,500	41,500	100,800
Fuel wood	8,100	16,600	- -	97,800	15,900	27,400	165,800
Fence posts	- -	100	1,700	100	- -	28,400	30,300
Hewn ties	- -	- -	- -	9,200	- -	- -	9,200
Misc.	- -	- -	1,900	1,000	300	9,100	12,300
Total	44,500	78,[illegible]00	70,600	436,700	109,600	183,400	923,700

1/Includes the sawlog portion of saw-timber trees, the usable volume in the upper stems of softwood saw-timber and in small trees from 5.0 inches d.b.h. to saw-timber size.

Table 14. - The effect of growth, mortality, and commodity drain upon the forest growing stock in the Virginia Mountains, 1940

IN BOARD FEET (INT. ¼-INCH RULE)

Species and diameter group	Growing stock Jan. 1, 1940	Gross growth	Mortality	Net growth	Commodity drain	Net change	Growing stock Jan. 1, 1941
	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.	Million bd. ft.
Softwoods:							
10-12 inches	476.2	33.6	2.4	31.2	14.9	16.3	492.5
14-18 inches	441.4	23.2	5.2	18.0	21.6	3.6	437.8
20 and over	294.9	14.3	5.6	8.7	14.0	-5.3	289.6
Total	1,212.5	71.1	13.2	57.9	50.5	7.4	1,219.9
Hardwoods:							
14-18 inches	1,948.7	104.9	4.3	100.6	78.5	22.1	1,970.8
20 and over	1,787.9	85.2	5.5	79.7	82.5	-2.8	1,785.1
Total	3,736.6	190.1	9.8	180.3	161.0	19.3	3,755.9
All species	4,949.1	261.2	23.0	238.2	211.5	26.7	4,975.8

IN CUBIC FEET

Species and diameter group	Growing stock Jan. 1, 1940	Gross growth	Mortality	Net growth	Commodity drain	Net change	Growing stock Jan. 1, 1941
	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
Softwoods:							
6-8 inches	133.5	7.3	1.0	6.3	3.2	3.1	136.6
10-12 inches	133.6	9.0	0.8	8.2	4.2	4.0	137.6
14-18 inches	94.9	5.3	1.1	4.2	4.6	-0.4	94.5
20 and over	55.0	2.6	1.0	1.6	2.6	-1.0	54.0
Total	417.0	24.2	3.9	20.3	14.6	5.7	422.7
Hardwoods:							
6-12 inches	778.1	39.5	2.4	37.1	17.8	19.3	797.4
14-18 inches	380.0	19.9	0.9	19.0	14.8	4.2	384.2
20 and over	307.3	14.7	1.0	13.7	14.1	-0.4	306.9
Total	1,465.4	74.1	4.3	69.8	46.7	23.1	1,488.5
All species	1,882.4	98.3	8.2	90.1	61.3	28.8	1,911.2

DEFINITION OF TERMS

Land-use Classes

Commercial forest. -- Forest land having qualities essential to the production of merchantable timber.

Non-commercial forest. -- Forest land lacking qualities essential to the production of merchantable timber.

Public reserved forest. -- Forest land in federal and state ownership upon which commercial timber cutting is prohibited.

Crop-land. -- Non-forest land used for production of farm crops within the last five years.

Abandoned crop-land. -- Land once cultivated, now evidently abandoned for farm crops, but not bearing forest cover.

Pasture. -- Cleared, fenced lands that are used primarily for grazing.

Marsh. -- Low, boggy, non-forested areas bordering water bodies and streams, where drainage is too poor to permit agricultural use.

Other non forest. -- Includes areas within the corporate limits and suburban or industrial sections of towns and cities; power, rail, and highway rights-of-way; sand dunes, water areas, and other miscellaneous non-forest land.

Forest Types

Loblolly pine. -- Stands in which softwoods make up 25 percent or more of the dominant and codominant trees with loblolly pine predominating. Includes pond pine in the Coastal Plain.

Shortleaf pine. -- Stands in which softwoods make up 25 percent or more of the dominant and codominant trees with shortleaf pine predominating. Redcedar is included here, although it forms a distinct type over limited areas.

Virginia pine. -- Stands in which softwoods make up 25 percent or more of the dominant and codominant trees with Virginia pine predominating.

White pine. -- Stands in which softwoods make up 25 percent or more of the dominant and codominant trees with white pine predominating.

Bottomland hardwoods. -- Stands of mixed hardwoods in swamps and along streams in which hardwood species make up 75 percent or more of the dominant and codominant trees. Includes cypress and white-cedar in the Coastal Plain.

Cove hardwoods. -- Stands in which yellowpoplar, cucumber, red maple, white ash, black birch, and basswood make up 75 percent or more of the dominant and codominant trees, usually found on lower north slopes and in coves along small streams. Includes stands of northern hardwoods in which sugar maple, beech, and yellow birch make up 75 percent or more of the overstory.

Upland hardwoods. -- Stands on well drained, upland sites in which mixed oaks and other hardwoods constitute 75 percent or more of the dominant and codominant trees.

Diameters

D.b.h. (diameter at breast height). -- Diameter in inches, outside bark, measured at $4\frac{1}{2}$ feet from the ground.

Diameter class. -- All trees were tallied by 2-inch diameter classes, each class including diameters 1.0 inch below and 0.9 inch above the stated midpoint; e.g., trees 7.0 to and including 8.9 inches are placed in the 8-inch class.

Forest Condition

Saw timber. -- Stands containing sufficient volume in merchantable species to make at least 600 board feet per acre in the pine types and 1,000 board feet per acre in the hardwood types.

Cordwood. -- Stands of second growth in which the total saw-timber volume is less than the required minimum for sawlog stands, with the remaining trees averaging more than 1.0-inch d.b.h.

Reproduction. -- Stands of young second-growth with little or no volume in trees over 1" in diameter, but bearing at least 80 well distributed seedlings per acre.

Tree Classification

Sound saw-timber tree. -- A softwood tree at least 9.0-inches d.b.h., and a hardwood tree at least 13.0-inches d.b.h. with not less than one sound butt log 12 feet long, or with 50 percent of the gross volume of the tree in sound saw timber.

Sound cordwood tree. -- Any sound, straight boled tree between 1.0-inch d.b.h. and sawlog size.

Cull tree. -- Any tree that fails to qualify as a sound tree because of poor form, excessive limbiness, rot, or other defect.

Volume Estimates

Board-foot volume. -- The volume in board feet, measured by the International $\frac{1}{4}$-inch rule, exclusive of defect, of that portion of sound sawlog-size trees between the stump and the upper limit of merchantability for sawlogs.

Cordwood volume. -- The volume in standard cords of the sound portion of trees 5.0-inches d.b.h. and larger between stump and a minimum diameter of approximately 4.0-inches outside bark.

Cubic-foot volume. -- The solid cubic volume, excluding bark, of all material included in the cordwood estimate.

Growing stock. -- The volume of wood in living trees excluding that in cull trees and hardwood tops.

Standard cord. -- A stacked pile, measuring 4 ft. x 4 ft. x 8 ft., of round or split bolts, estimated to contain 90 cubic feet of softwood (wood and bark) or 80 cubic feet of hardwood (wood and bark).

International log rule. -- A rule for estimating the board-foot volume of four-foot log sections according to the formula $V = .905\,(0.22D^2 - 0.71D)$. The taper allowance for computing the volume in log lengths greater than four feet is .5 inch per four-foot section.

Utilization

Commodity drain. -- The volume of wood cut in the designated area from sound living trees, adjusted for such cutting practices as may over-cut or under-cut the basic volume tables, and excluding the cordwood volume cut from tops of hardwoods.

FOREST SURVEY RELEASE NO. 12 APRIL 1, 1943

THE FOREST SITUATION IN THE COASTAL PLAIN OF VIRGINIA

by

J. W. Cruikshank
Regional Survey Director

A FOREST SURVEY PROGRESS REPORT

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

Appalachian Forest Experiment Station
R. E. McArdle, Director
Asheville, N. C.

PREFACE

Through the McSweeney - McNary Act of May 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act, and each of the 12 Regional Experiment Stations is responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station, Asheville, North Carolina.

The work of the Survey is divided into 5 major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of the timber on these lands.

2. Growth. Determination of the current rate of timber growth.

3. Drain. Determination of the amount of industrial and domestic wood use, and the total loss from fire, insects, disease, suppression, and other causes.

4. Requirements. Determination of the current and probable future requirements for forest products, by all classes of consumers.

5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis for public and private policies and plans of forest land use and management.

This progress report presents preliminary information on the first three of these phases for the Coastal Plain of Virginia (Unit 1), one of the 5 survey units into which the State was divided. A similar release will be prepared for the Piedmont Region (Units 2 and 3) and for the Mountain Region (Units 4 and 5).

Information on [illegible] field survey made in the spring of 1941. A total of 7,880 sample plots was established at [illegible] miles apart, extending [illegible] statistical sample [illegible] all area and volume estimates in this report, except where other sources are directly credited. Owing to the method of sampling, small tabular items have the greater probability of error and should be considered as indicating relative magnitude rather than actual values.

Data on consumption of forest products for industrial and domestic purposes were obtained by canvassing all primary manufacturing plants and a number of representative domestic consumers.

Forest Survey Staff
Assisting in the Preparation of this Report

E. V. Roberts - Formerly Regional Survey Director.
T. C. Evans - Compilation and analysis of inventory and growth data.
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QUICK FACTS

The Coastal Plain of Virginia, Forest Survey Unit 1, contains 6,362,900 acres of land, one-fourth of the total area of the State.

In 1940 the total population was one million, one-half in cities, one-fourth in small towns, and one-fourth on farms.

Urban centers increased in population more than 13 percent between 1920 and 1940, but the rural population increased only one percent in the same period. Rural population decreased in 24 of the 34 counties.

Between 1900 and 1940 the number of farms decreased by 22 percent and the acreage of improved land was reduced by 35 percent.

Abandonment of improved farm land has averaged about 20,000 acres per year since 1900.

One-half of the manufacturing plants in the State and two-fifths of the employees in manufacturing industries are in the Coastal Plain in normal times. War has caused a great influx of industrial workers into the Hampton Roads area.

Forest industries rank second as a source of manufacturing employment.

Sixty-two percent of the land is forested, altogether 3,943,800 acres.

Forty-eight percent of the forest is farm woodland, 13 percent is owned by operating forest industries, 37 percent is held by other private owners, and 2 percent is publicly owned.

One-half of the forest area is stocked with loblolly pine.

Sixty-three percent of the forest land is stocked with saw timber, and 37 percent with young second growth and reproduction. Less than 5 percent of the saw-timber area is old growth.

The total volume by the International $\frac{1}{4}$-inch log rule is 11.7 billion board feet, two-thirds softwood and one-third hardwood. Fifty-two percent of the total volume is loblolly pine.

The total volume of sound wood is 74.3 million cords including bark, 66.0 million in sound trees and 8.3 million in cull trees.

Net annual increment in 1940 amounted to 513 million board feet of softwoods and 236 million feet of hardwoods, a total of 749 million feet.

The total commodity drain by all primary industries and domestic consumers amounted to 606 million board feet or 2.1 million cords.

In the softwoods net increment exceeded drain by 12 million board feet or 198,000 cords.

In the hardwoods net increment exceeded drain by 131 million board feet or 805,000 cords.

FOREST RESOURCES OF THE COASTAL PLAIN OF VIRGINIA

GENERAL DESCRIPTION

Natural Conditions

Forest Survey Unit 1 in Virginia borders the Atlantic seaboard and extends from the Potomac River south to the North Carolina line (fig. 1). It includes all of the Coastal Plain and such areas of the Piedmont as were necessary to adjust the unit to county boundaries. The 34 counties included therein contain 6,362,900 acres, one-fourth of the land in the State.

Topography: This distinct physiographic province is about 125 miles long from north to south and, including Accomac and Northampton counties on the Eastern Shore, is about 125 miles wide. It is a gently undulating plain, descending from an elevation of about 300 feet at its western boundary with the Piedmont to sea level at its eastern extremity. The area lying between the coast and the range of high tide in the major water courses is known as the Tidewater. Four major rivers break the northern and central part of the region into three long peninsulas and a fourth,

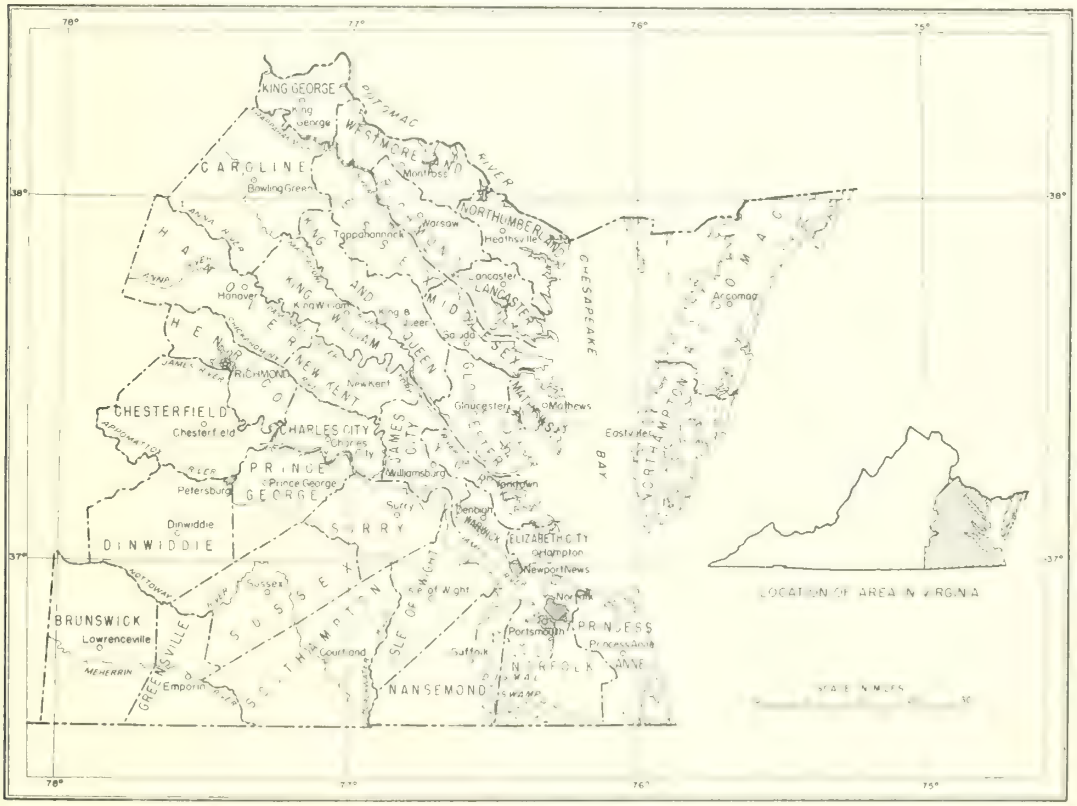

FIGURE I.- THE COASTAL PLAIN OF VIRGINIA, FOREST SURVEY UNIT NO. I

the Eastern Shore, is separated from the Virginia mainland by the broad reaches of Chesapeake Bay.

Drainage: Five large rivers; the Potomac, the Rappahannock, the York, the James, and the Chowan drain the area. The first four of these flow southeast into Chesapeake Bay and are wide, sluggish, tidal rivers throughout practically their entire length in the Coastal Plain. In conjunction with Chesapeake Bay they form an excellent system of natural harbors, important commercially and even more important from a naval and military standpoint. The Chowan River is in North Carolina, emptying into Albemarle Sound, but the Blackwater, Nottoway, and Meherrin Rivers are important tributaries in Virginia draining a large part of the land south of Petersburg. The Dismal Swamp, lying between Suffolk and Portsmouth, extends south into North Carolina and drainage from this vast depression is chiefly by streams flowing into Albemarle Sound.

Soils: Soils are of three general groups, the poorly drained soils in the swamps and along the tidal streams, the light sandy loams of sedimentary origin on the inter-stream uplands in the Tidewater area, and the clay and sandy loams derived through decay of the underlying rocks in the border zone between the Coastal Plain and the Piedmont. In the first group are the peat soils of the Dismal Swamp, the swamp soils occurring in strips of a few hundred feet to several miles in width along the streams, and the tidal marsh lying between the upland soils and tidewater. Both the peat and swamp soils support a forest cover where not used for agriculture. The soils of the sandy loam group occur in many soil series although the Norfolk and Sassafras sandy loams are particularly abundant and are very productive agricultural soils when fertilized. Less desirable for crops but suitable for timber growing are the poorly-drained types of the Bladen, Lenoir, and Plummer series. Merging onto the Piedmont the clay and sandy loam soils are frequently of the Cecil and Durham series. They usually have a clay subsoil and are subject to sheet erosion. Where erosion and soil exhaustion are severe forests provide an effective method of using and rebuilding the land.

Climate: The climate is mild and conducive to rapid growth of farm and forest crops. Average annual precipitation ranges from about 40 inches along the coast to 48 inches in a narrow belt lying east of Waverly and Emporia. West of this zone the annual precipitation drops gradually to about 42 inches along the western border of the Coastal Plain. July is the wettest month with about 5 inches of precipitation and November is the driest with about 2 inches. Snowfall averages about 9 inches per year at Norfolk, about 16 at Richmond and nearly 17 on the Northern Neck between the Potomac and Rappahannock Rivers.

July and August are the hottest months with an average maximum temperature of about 86° and December, January, and February are the coldest with an average minimum of about 30°. Killing frosts occur about the last of October and can be expected until about the 15th of April. The area surrounding Norfolk has a growing season of about 235 days but the remainder of the region averages about 200 days.

Social and Economic Conditions

Historical: In May 1607 the first permanent English settlement in North America was made in Tidewater Virginia at Jamestown on the James River by a small band of colonists dispatched by the Virginia Company of London. In 1612 John Rolfe introduced the cultivation of tobacco and by 1619 plantations had been established up and down both sides of the James River. By 1700 the population had reached about 70,000 and tobacco was being produced on an increasingly large scale. About this time the importation of negro slaves increased sharply and in 1715 they made up one-fourth of the total population. Just before the Revolutionary War Tidewater Virginia experienced great prosperity as the expansion of slavery and profitable markets resulted in the export of millions of pounds of tobacco. In 1755 there were about 175,000 whites and 120,000 negroes in the region.

Between 1817 and 1830 eastern Virginia experienced a great depression, due in part to the exhaustion of the soils used so intensively for tobacco. Some tobacco growers abandoned their farms and plantations and moved West or South while others substituted cotton for tobacco and tried to rebuild their worn out land. With the soil resource severely depleted for agricultural use after more than a century of exploitation many plantation owners accepted the negro as their major resource. Between 1830 and 1860 Tidewater Virginia supplied a great many of the negroes used in the cotton fields of the Deep South although the records show that in 1860 only 114 individuals in all Virginia owned as many as 100 slaves.

Following the Civil War Virginia was controlled by the Federal Army until 1870. During this time economic progress was slow because government was confused, negroes were a problem, farms and factories were ruined, credit was hard to obtain, and transportation facilities were poor. In the fall of 1869 the voters complied with the terms of the Reconstruction Act and on January 26, 1870, the State ceased to be a Military District. This marked the beginning of Virginia's recovery from the slave system and the War. In the ensuing years Virginia has made steady progress in building a sound social and economic system.

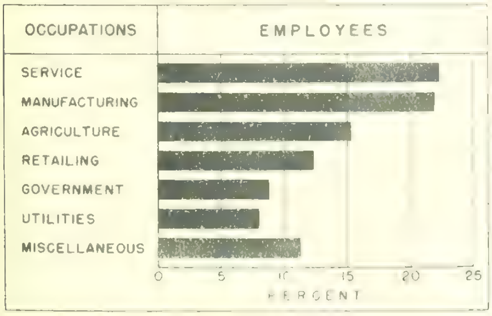

FIGURE 2 - OCCUPATIONS OF EMPLOYED, 1940.

People: In 1900 the total population of the Coastal Plain of Virginia was about 659,000. Total population has increased with each succeeding decade and in 1940 the Bureau of the Census reported the region contained one million people. Approximately one-half of these lived in cities of more than 2,500 inhabitants, one-fourth lived in small towns and communities, and one fourth lived on farms. About 386,000 people were employed in 1940 and they were distributed among the major occupations as indicated in figure 2. Nearly 47 percent of all the people lived in the six cities with more than

10,000 inhabitants -- Richmond, Norfolk, Portsmouth, Newport News, Petersburg, and Suffolk. Richmond is the largest city with a population of 193,000 but almost one-fourth of all the people in the Coastal Plain live in Norfolk, Portsmouth, and Newport News, located at the mouth of the James River. Since the taking of the census on April 1, 1940, the population of this area has increased rapidly because of defense activities; and, if the war does not end in the next four or five years, the population may double by that time.

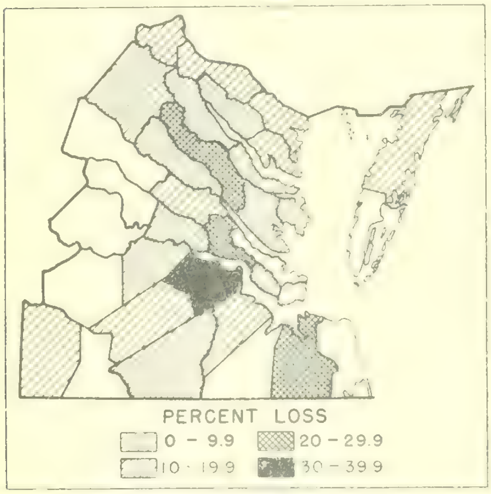

FIGURE 3- COUNTIES LOSING RURAL POPULATION BETWEEN 1920 & 1940.

Urban centers increased in population over 13 percent between 1920 and 1940 but the rural population, including small towns of less than 2,500 inhabitants, increased only one percent during the same period. In 24 counties (fig. 3) the rural population actually decreased in the past 20 years, with losses ranging from 2.7 percent in Sussex County to 33.4 percent in Surry County. Many of the counties north of the James River have a smaller rural population now than in 1900. Soil depletion and opportunities for industrial employment in urban centers have caused many rural people to move to the cities with the result that urban population increased in 11 counties between 1920 and 1940. Industrial development was the basis for most of the increase in Henrico, Chesterfield, Prince George, Warwick, Norfolk, Nansemond, Southampton, and Greenville counties but the urban growth of James City was probably due to the restoration of Williamsburg, that of Princess Anne was probably due to the recreational attractions of Virginia Beach, and that of Elizabeth City was likely due to shipbuilding at Newport News and to military activities at Langley Field and Fort Monroe.

Agriculture: In the four decades between 1900 and 1940 farm land has been abandoned at an average rate of about 32,000 acres per year, thus reducing the farm area by 1.3 million acres or 27 percent. Paralleling this reduction in total farm acreage was the shrinkage in the area of improved farm land - cropland and open pasture, amounting to 774,000 acres (table 1). A large part of the abandoned farm land has restocked to trees and as a result the total forest acreage is increasing while the area of land in agricultural use is gradually decreasing.

Farm land abandonment and a declining rural population have caused a reduction in the total number of farms, from about 51,000 in 1910 to about 38,000 in 1940. With a decrease in both acreage and number of farms the average size of farm has remained relatively constant in the past 40 years. In 1940 the average farm contained 93 acres of which 50 were wood land and 26 were cultivated cropland.

Table 1. - Farms and farm areas in the Coastal Plain, 1900-1940[1]

Year	Farms	All land in farms		Improved land in farms		Farm woodland	
	Number	Acres	Percent	Acres	Percent	Acres	Percent
1900	48,640	4,827,928	74.6	2,214,989	34.2	-----	-----
1910	51,128	4,587,825	70.9	2,021,722	31.2	-----	-----
1920	51,239	4,199,351	64.9	1,804,343	27.9	2,114,746	50.4
1930	43,078	3,699,588	57.2	1,674,986	25.9	1,808,374	48.9
1940	37,894	3,536,632	55.6	1,441,245	22.7	1,889,479	53.4

[1] U. S. Dept. of Commerce, Bureau of the Census.

The climate, topography, and soils of coastal Virginia are suitable for the production of a rather large variety of agricultural crops. Corn, small grains, and hay are grown in practically every county and account for three-fourths of all the harvested cropland. Peanuts are a leading crop south of the James River. Southampton County is the leading producer, but Sussex, Isle of Wight, and Nansemond are close rivals. Winter wheat is grown in the Northern Neck and in the counties bordering the Piedmont, altogether about 50,000 acres in 1939. Every county produced some Irish potatoes in 1939 but two-thirds of the total acreage, 46,000, was in Accomac and Northampton counties on the Eastern Shore. About 9,500 bales of cotton were grown, chiefly in Southampton, Greensville, Brunswick, and Nansemond counties. Sixteen million pounds of tobacco were harvested and most of this was raised in Brunswick and Dinwiddie counties. Sweet potatoes and yams are cultivated in every county and truck crops are produced on a large scale in the Tidewater area. About 15 local veneer and cooperage plants make crates, baskets, and barrels for marketing the vegetables and Irish potatoes.

Livestock is not a major source of income. Three-fifths of the farms are stocked with dairy cattle, but with an average of less than three head per farm. Only 2 percent of the farm operators reported owning beef cattle in 1939, and these few operators averaged only seven head each. Hogs are more numerous, as there were an average of six on two-thirds of the farms. They are particularly abundant in the peanut-growing counties and the hams cured at Smithfield in Isle of Wight County are world famous.

Manufacturing: According to the 1937 Census of Manufactures approximately one-half of the manufacturing plants and two-fifths of the wage earners in the State are in the Coastal Plain. With the exception of the primary wood-using industries, which are widely scattered, most of the manufacturing is concentrated in the larger cities. Richmond is the leading industrial center and is closely followed by the Norfolk, Portsmouth, and Newport News area. Petersburg is the third-ranking manufacturing district and the only other concentrations of manufacturing plants are at Suffolk and Hopewell. Numerous sea-food and vegetable packing plants are scattered throughout the Northern Neck and to a lesser extent on the Eastern Shore. Several fertilizer and fish oil plants also operate in this general locality.

Industrial activity is widely diversified and each of the important manufacturing centers turns out a variety of products. In Richmond, where the 1937 Census of Manufacturers reported 301 industrial plants employing 18,014 wage earners making products valued at 338 million dollars, the leading products are cigarettes and tobacco, rayon and cellophane, paper and paper products, and iron and steel. Shipbuilding is the major industry in the Norfolk area, although railroad repair shops, fertilizer plants, and forest products industries are prominent. Petersburg manufactures tobacco, textiles, peanuts, and various other products but is chiefly famed for its trunk and baggage factories. Suffolk specializes in the manufacture of peanuts and various kinds of forest products. Hopewell, a small but highly industrialized community, is the site of large plants making paper and paper board, nitrate of soda, chemical cotton, and knit goods.

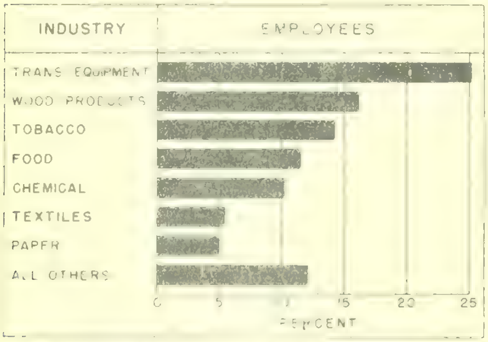

FIGURE 4 - DISTRIBUTION OF EMPLOYEES IN THE MANUFACTURING INDUSTRIES, 1940

In 1937 the total number of active manufacturing plants in the Coastal Plain of Virginia was 1,135 according to the Bureau of the Census. This total includes the larger primary forest industrial plants but omits many of the small portable sawmills that are difficult to locate and change location frequently. Employment was furnished to 57,000 wage earners, who received about 34 million dollars in wages. They made goods valued at 493 million dollars, adding nearly 153 million dollars of value through manufacture. The distribution of employees among the manufacturing industries in 1940 is indicated in figure 4. In the Coastal Plain shipbuilding is now the leading manufacturing industry, but wood products rank next.

Taxation: Property in Virginia is divided into the following principal classes for purposes of taxation; real estate, tangible personal property, machinery and tools, merchants' capital, intangible property, bank stock, and the property of public service corporations.

The combined county and district levy upon real estate in 1940 ranged from $1.10 per $100 of assessed valuation in Newville District of Sussex County to $3.50 per $100 in Pungo District of Princess Anne County. Assessed value of forest land frequently has little relation to the actual value and both overassessment and underassessment are common. In general assessed values range from about $4.00 per acre for young second growth up to $20.00 per acre for good quality saw timber. At a rate of $1.80 per $100, which is about average for the Coastal Plain, the corresponding tax per acre varies from 7 to 36 cents. Tax delinquency apparently is not a serious problem at present for only 2.3 percent of all the local taxes levied in the seven tax years ending in 1939 were not paid by 1940. Delinquency was highest in Northampton and Accomac counties.

Table 2. - Distribution of all land by class of owner, 1940

Class of owner	All land	
	Acres	Percent
Farm:		
Owner operators	2,379,200	37.4
Nonresident owners	1,157,400	18.2
Forest industries	504,000	7.9
Other private	2,161,100	34.0
Federal	143,200	2.2
State	18,000	0.3
Total	6,362,900	100.0

Land ownership: Almost 98 percent of the land in the Coastal Plain is privately owned with the largest proportion (table 2) in farm ownership. On the basis of statements obtained at each of the operating forest products plants the primary forest industries own only half a million acres of timberland, about 8 percent of the total land area. Over 2 million acres, one-third of the total, is held by nonfarm and nonforest-industry owners. Part of this land is in towns and cities, rights-of-way, and industrial sites but a large share of it is undoubtedly rural land abandoned over the past half century. Owners of this land are wage earners, merchants, bankers, and professional people who live in small towns and the larger cities. They are a very important class of land-owner but they exert a minimum of supervision over their land which usually lies idle or reverts to forest.

The Federal Departments of War, Navy, Justice, Commerce, and Interior have land in the Coastal Plain. These lands are used for a variety of purposes and many of the tracts consist of a very few acres. A partial list would include cemeteries, army forts, landing fields, ordnance and ammunition depots, proving grounds, navy yards, reformatory camps, lighthouse stations, Coast Guard stations, and military parks. The War Department administers the most land; the largest tract under its jurisdiction is the recently acquired A. P. Hill Military Reservation in Caroline County.

Several commissions, departments, and institutions control the 18,000 acres in State ownership. About 6,700 acres are included in the grounds of state-supported schools and colleges and the State Capitol, 4,700 acres are in the Westmoreland and Seashore State Parks and 4,000 acres are managed for game farms, refuges, and hatcheries. Three Indian reservations contain 2,000 acres and the remaining 600 acres are distributed among experiment stations, farms, roadside parks, and the State Military Reservation.

Forest land in public ownership (table 3) is estimated to be about 100,000 acres. A large part of this acreage is in the A. P. Hill Military Reservation, the Yorktown Mine Depot, Camp Lee, the Reformatory Camp of the Department of Justice, and the two State Parks.

Table 3. - Ownership of forest land, 1940

Class of owner	Forest land	
	Acres	Percent
Public:		
Federal	94,800	2.4
State	6,900	0.2
Total	101,700	2.6
Farm woodlands:		
Owner operators	1,271,600	32.2
Nonresident owners	617,900	15.7
Total	1,889,500	47.9
Forest industries:		
Lumber	366,500	9.3
Pulp and paper	122,000	3.1
Excelsior, stave, veneer	15,500	0.4
Total	504,000	12.8
Other private	1,448,600	36.7
All classes	3,943,800	100.0

Nearly one-half of the forest land is on going farms and two-thirds of this farm woodland is held by farmers who own or partially own their land. One-third of the farm woodland, 16 percent of the total, is owned by nonresident farm owners, and the care of the timber rests chiefly upon tenants and croppers. Forest industries own nearly 13 percent of the timberland and the 504,000 acres is divided among 180 lumber producers, 4 pulp and paper companies, and 13 manufacturers of staves, excelsior, and veneer. Operators of sawmills cutting less than 10,000 board feet per day reported they owned 94,000 acres of forest land. The forest in other private ownership, over one-third of the total, is the timbered portion of the land previously described as belonging to nonresident people who live in rural communities, small towns, and the larger cities.

Distribution of forest land by class of owner is particularly significant when considered in relation to the forestry programs being developed to improve forest management practices. Present emphasis by Federal and State forestry agencies is upon the forest land in farm and industrial ownership and frequently only upon the larger owners in these two classes. Little contact is made with nonresident owners of farm woodlands and other private owners who are not farmers or forest industrialists. In practice this means that most of the effort is expended upon 45 percent of the forest land and the other owners, with over half the land, hear little about forestry.

Table 4. - Total land area classified by major use, 1940

Land use	Area	
	Acres	Percent
Forest:		
Commercial	3,919,200	[illegible]
Reserved public	24,600	0.4
Total forest	3,943,800	62.0
Nonforest:		
Agriculture:		
Old cropland	1,656,200	26.0
New cropland	28,200	0.4
Pasture	150,500	2.4
Total agr.	1,834,900	28.8
Abandoned cropland	82,100	1.3
Other nonforest	502,100	7.9
Total nonforest	2,419,100	38.0
All uses	6,362,900	100.0

Land use: According to the Forest Survey 62 percent of the land is used for growing timber and 38 percent is nonforested (table 4). Less than

25,000 acres of the forest land is reserved from cutting in Federal or State Parks, all the rest, 3.9 million acres, is classified as commercial timber land.

The 2.4 million acres of nonforest land is chiefly cropland, old, new, and abandoned. Old cropland includes land under cultivation and still workable land cultivated within the last five years. It therefore includes some recently abandoned fields which will gradually restock with trees unless cultivated again within the next few years. Newly cleared land is insignificant in amount. Abandoned cropland is definitely unsuitable for further agricultural use because of erosion, soil exhaustion, or other causes. It could be restored to productivity by planting to forest trees. Most of it is located in the Upper Coastal Plain. Pasture land, which is cleared and fenced, is distributed throughout every county but is most abundant in Brunswick, King George, Hanover, and Dinwiddie counties. The remaining nonforest area consists of land occupied by towns and cities, industrial sites, rights-of-way, marsh, and rural nonfarm homes. In addition it includes the nonwooded portion of reserved public land.

DESCRIPTION OF THE FOREST RESOURCE

Commercial forests occupy 3.9 million acres, 62 percent of all the land. Loblolly pine is the predominant species but sweetgum, red oaks, white oaks, black and water tupelos, yellowpoplar, shortleaf and Virginia pines are comparatively common (fig. 5). Topography, soils, fire, cutting, and land abandonment have all influenced the species composition of the forest but there are six rather distinct species associations or forest types.

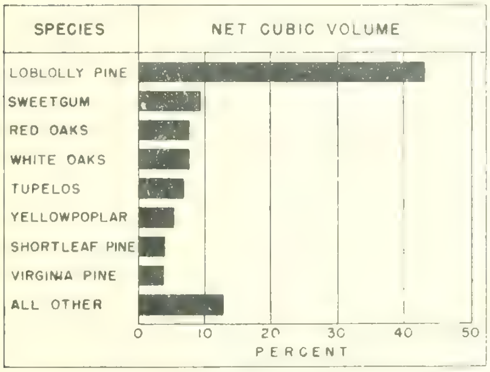

FIGURE 5 - SPECIES COMPOSITION OF THE FOREST, 1940.

Forest Types

Loblolly pine: The loblolly pine type covers forty-nine percent of the forest land and is the major type south of the Rappahannock River drainage basin (fig. 7). Within the Dismal Swamp loblolly pine is of scattered occurrence on the higher less swampy land and it has restocked in pure stands the abandoned fields around the edge of the Swamp. The type grows on practically all sites, occurring in the bottom lands of the larger rivers, the inter-stream uplands of the Tidewater, and the rolling hills of the Upper Coastal Plain. Pure stands of loblolly pine are common, particularly upon the abandoned fields, but other pines and hardwoods are frequent associates. For the type as a whole 73.0 percent of the net cubic volume is loblolly pine, 8.3 percent is red and white oaks, 6.0 percent is sweetgum, 4.9 percent is shortleaf and Virginia pine and the rest is chiefly yellowpoplar, tupelo and red maple.

Upland hardwoods: The upland hardwoods type is only one-half as extensive as the loblolly pine type (fig. 6). It occurs closely associated with the loblolly pine forest on the better-drained uplands and is often the residual stand left after the pine is cut out. It is seldom the major type over any extensive area and for this reason is not shown on the forest type map (fig. 7). Red and white oaks are the leading species accounting for 39.0 percent of the net cubic-foot volume in the type. Other leading species make up the following proportions of the type volume: sweetgum 12.2 percent, beech 8.2 percent, hickories 7.2 percent, and loblolly pine 7.2 percent.

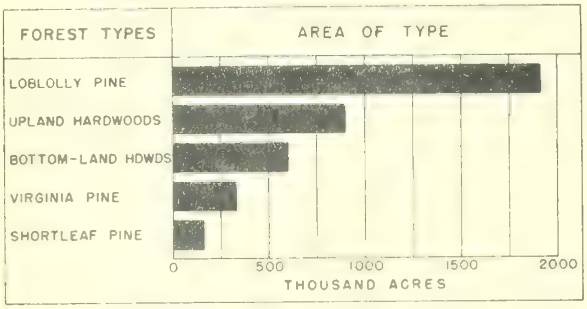

FIGURE 6 - DISTRIBUTION OF FOREST AREA BY FOREST TYPE, 1940.

Bottom-land hardwoods: About 15 percent, 608,000 acres, of the forest is composed of the bottom-land hardwoods type. It occurs along most of the larger rivers above the tidal marshes and in the Dismal Swamp. Black and water tupelos, sweetgum, red maple, cypress, and Atlantic white-cedar are the leading components of this type (table 22, Appendix). Red and white oaks are common but relatively less abundant.

There are approximately 90,000 acres in the Dismal Swamp in Virginia and of these, 84,000 are forest land. The bulk of this area, 52,000 acres, has been heavily cut-over and burned and the present vegetative cover consists of a dense jungle of briars penetrated occasionally by young red maples or black tupelos. Because these young trees have at least partially stocked the land it was not classified as clear-cut by the Forest Survey even though such areas are locally referred to as "lights" or "open ground." The timbered portion of the Swamp, about 32,000 acres, is stocked with sweetgum, black tupelo, cypress, and red maple growing in mixture and with Atlantic white-cedar growing in relatively pure stands. Most of the estimated 8,000 acres of white-cedar lies southwest of Lake Drummond. In January 1940 approximately one-third of the timbered land supported old growth, chiefly black tupelo, cypress, and red maple.

Virginia pine: The Virginia pine type extends from the Piedmont across the Coastal Plain almost to Chesapeake Bay in a belt about 25 miles wide paralleling the Potomac River. It occupies about 331,000 acres of land, 8 percent of the forest area. Forty-two percent of the net cubic volume of the type is Virginia pine, 20 percent is loblolly pine, and 10 percent is red oak. White oak, yellowpoplar, and sweetgum are also common associates of Virginia pine in the pine-mixed hardwood phase of this type.

Shortleaf pine: The shortleaf pine type is of limited extent in the Coastal Plain, occupying only 164,000 acres, 4 percent of the forest

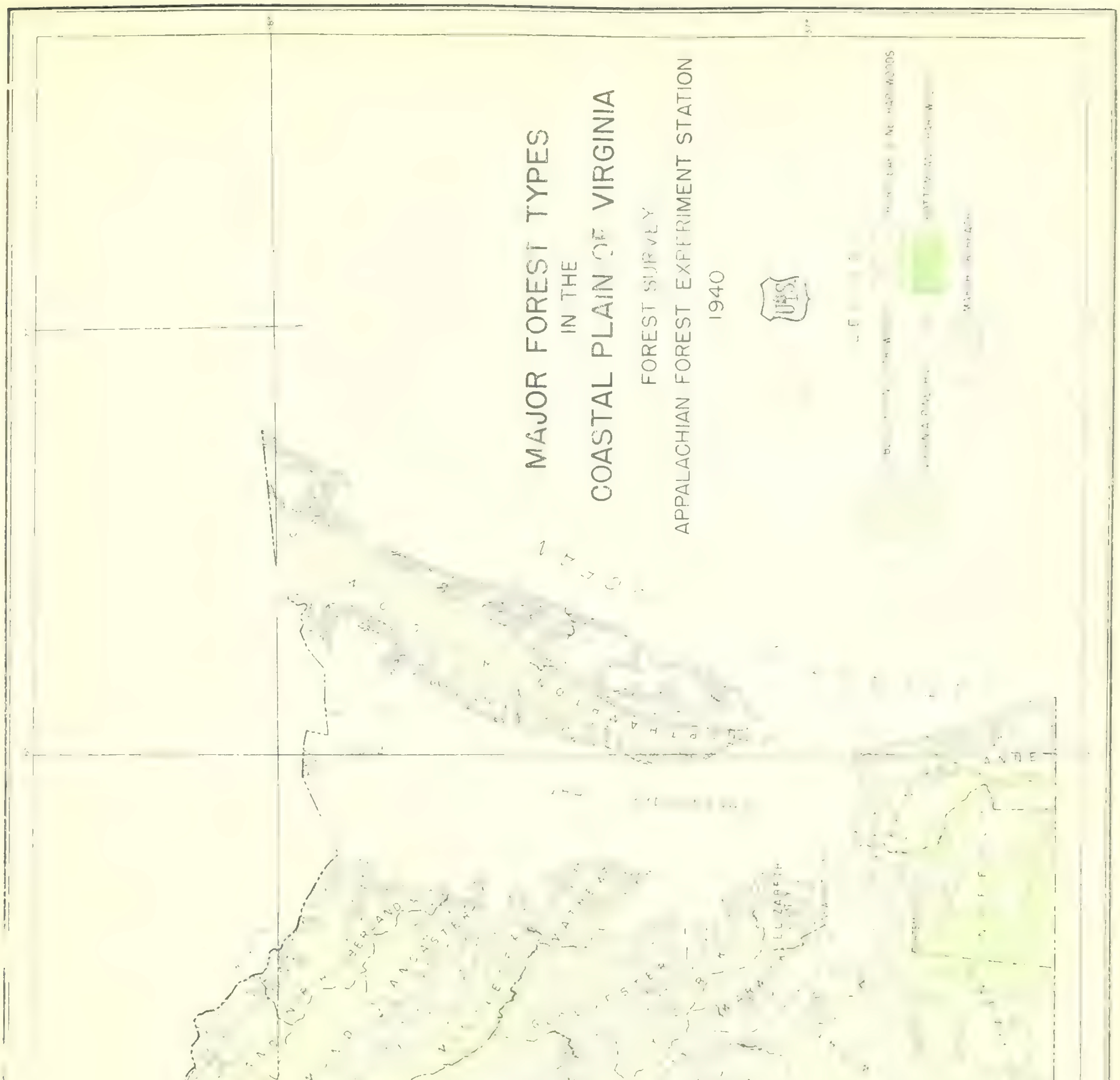
MAJOR FOREST TYPES
IN THE
COASTAL PLAIN OF VIRGINIA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1940
WESTMORELAND
LANCASTER
NORTHUMBERLAND
GLOUCESTER
MATHEWS
ELIZABETH CITY
PRINCE GEORGE

FIGURE 7

land. It is the major type in the southwest portion of Hanover County and occupies a limited area west of Lawrenceville in Brunswick County, but elsewhere along the western boundary of the Coastal Plain is subordinate to the loblolly pine type. About 53 percent of the net cubic volume of the type is shortleaf pine and 17 percent is loblolly pine. Only one percent is Virginia pine. Hardwoods make up the remaining type volume with the red and white oaks, sweetgum and yellowpoplar the leading species.

Forest Conditions

The trees of coastal Virginia vary in age, size, and quality and the stands composed of these trees differ in volume-per-acre and in the degree to which they have been cut. These differences are the basis for classifying the forest into forest conditions.

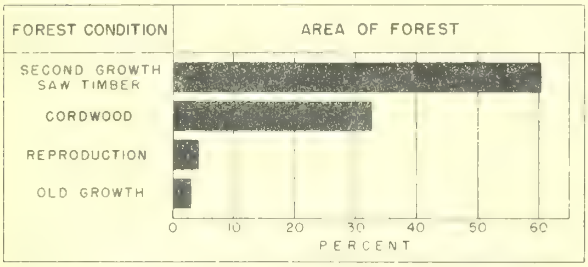

FIGURE 8 - DISTRIBUTION OF FOREST AREA BY FOREST CONDITION, 1940.

Second-growth saw timber: This condition class occupies 2.3 million acres of land, 60 percent of the forest area (fig. 8). It is found on 50 to 60 percent of all type areas except loblolly pine which has 65 percent of its area stocked with merchantable second growth. Most of the pine stands in this condition range in age from 30 to 60 years and most hardwood stands range from 50 to 100 years. Volumes per-acre vary with the number and size of trees and forest type, but average volumes per acre in uncut stands range from 2,920 board feet in the upland hardwoods type to 6,020 in the cypress - white-cedar species association. Partly-cut stands vary from 2,120 to 5,460 feet in the same types. Approximately one-fourth of the second-growth saw timber has been partially cut-over for particular species or sizes, a process that has affected the upland hardwoods type to the largest degree and the bottom-land hardwoods the least. On the basis of the sample plots recorded by the Forest Survey in each county over three-fourths of the forest in James City, Mathews, Princess Anne, and Southampton counties is second-growth saw timber, with smaller proportions in the other counties.

Cordwood stands: Young second growth timber occupies 1.3 million acres, 33 percent of the forest land. Stands in this classification contain less than 600 board feet per acre and are predominantly young growth from 1.0 inch d.b.h. to saw-timber size (pines 9.0 inches d.b.h. and hardwoods 13.0 inches d.b.h.). Forty-three percent of this young second growth is in the loblolly pine type and 29 percent is in the upland hardwoods type, the remaining acreage is chiefly bottom-land hardwoods and Virginia pine. Most of these young stands are less than 30 years old, although many stands of hardwoods require at least 50 years to reach an average diameter of 13.0 inches d.b.h. Volume-per-acre of these young stands are best expressed in cords and the average volume in trees 5.0 inches d.b.h. and larger varies from less than a cord in the cypress - white-cedar type to 7 cords in the upland hardwood type. The loblolly pine type averages 5.5 cords over 548,800 acres.

Reproduction: The reproduction condition class is limited to 165,800 acres, 4 percent of the forest land. This does not mean that reproduction is scarce in the forests of coastal Virginia, rather it means that all but this relatively small acreage is stocked to some degree with trees larger than 1.0 inch in diameter and consequently was classified in a higher category. Reproduction, as such, is present in most of these older stands. About 55 percent of the land stocked only with reproduction is coming back to loblolly pine, 20 percent to bottom-land hardwoods, and 14 percent to Virginia pine. Undoubtedly there must be some clear-cut areas not restocking to any species but they are not abundant as none were recorded by the Forest Survey.

Old growth: Old growth is the least extensive of the forest conditions, occupying only 111,900 acres, about 3 percent of the forest land. Settlement and land clearing for 300 years have removed practically all of the original virgin timber and most of the pine stands classified as old growth are in reality second-growth timber that has restocked abandoned fields more than 100 years ago. The major exception is the old-growth hardwood timber in the Dismal Swamp.

Site Quality

The soils and climate of eastern Virginia are conducive to rapid tree growth. Site quality, which is chiefly determined by these natural factors, is therefore high. It is measured in several ways, but a commonly used index for southern pine is the height of average dominant trees at 50 years of age. In table 5 the area of each of the pine types is classified into three degrees of site quality as follows: good -- land capable of growing loblolly pine trees 80 or more feet and Virginia and shortleaf pine 70 or more feet in height at 50 years of age; fair -- land capable of growing loblolly pine 60 or 70 feet in height and Virginia and shortleaf pine 60 feet; poor -- land capable of growing pine trees 50 feet or less in height.

Over 2 million acres, 87 percent, of the land stocked with pine is of fair to good site quality (table 5). Trees growing on this land will be tall, thrifty, well-formed and when merchantable will yield several sawlogs. Land stocked with loblolly pine is most productive and land in the shortleaf pine types, 40 percent of poor site, is least productive. A separate analysis of all old-field and forest-grown pine stands revealed that abandoned fields were less productive than forest soils, for the proportionate area in poor sites was nearly twice as large in the old-field stands as in forest-grown stands.

The hardwood land not shown in the table, was classified as good, fair, or poor using soil and moisture conditions and merchantable height and form of trees as criteria of site quality. Sites were found to be poorest in the swamps and best in the well-drained alluvial soils along the rivers. About 96 percent of the 1.5 million acres stocked with hardwood were classified as of fair to good site quality.

Table 5. - Land in pine types classified according to site quality, 1940

Forest type and site index class	Land in types	
	Acres	Percent
Loblolly pine		
Good	496,300	25.9
Fair	1,275,000	66.4
Poor	148,100	7.7
Total	1,919,400	100.0
Virginia pine		
Good	77,900	23.5
Fair	153,800	46.5
Poor	99,100	30.0
Total	330,800	100.0
Shortleaf pine		
Good	42,000	25.6
Fair	55,400	33.8
Poor	66,700	40.6
Total	164,100	100.0
All pine types		
Good	616,200	25.5
Fair	1,484,200	61.5
Poor	313,900	13.0
All sites	2,414,300	100.0

Age of Stands

The pine forests of coastal Virginia are composed of both even-aged and all-aged stands. Most of the even-aged stands have originated upon abandoned fields, frequently during a single good seed year. At least one-third of the stands are in this category. All-aged stands may consist of two or three distinct age classes, presenting a multistoried appearance, or they may be composed of many small groups of even-aged trees. This latter is the more usual form. Most of the pine stands reach minimum saw-timber size at about 30 years of age. On this basis the pine forest is in balance from an age-class distribution standpoint as about one-half of the pine type area supports stands more than 30 years old (fig. 9). If there is a deficiency it is in the stands over 60 years of age, which occupy less than one tenth of the pine area.

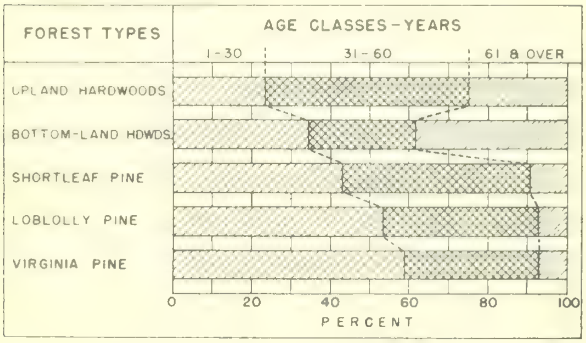

FIGURE 9 - DISTRIBUTION OF FOREST TYPE AREAS BY AGE CLASS, 1940.

Hardwood stands are usually all-aged, containing reproduction, saplings, and saw-timber trees. The occasional even-aged stands are sweetgum or yellowpoplar on abandoned fields, old-growth timber without an understory of young growth, and second-growth black tupelo. Only 30 percent of the hardwood type area supports stands over 60 years old, the minimum age of saw timber, but the age-class distribution in both the upland and bottom-land hardwoods is suitable for the continuous production of saw timber.

Stocking

Number of stems and volume of timber per acre vary widely between forest stands of the same age. Some of the old-field stands which have come in on small abandoned fields adjacent to a good source of seed are so densely stocked that growth is slow. On large abandoned fields the natural restocking has often been scattered and sparse and the subsequent stand is very poorly stocked. Forest fires have also destroyed many young trees in both old-field and natural-forest stands thus causing a lower degree of stocking.

Table 6. - Average volumes per acre in the uncut conditions of the pine types, 1940

Age class	Best 10 percent of stands	Average stands	Stocking of average stand
Years	Cords	Cords	Percent
11-20	7.6	3.1	41
21-30	22.2	10.2	46
31-40	35.6	18.5	52
41-50	43.6	23.6	54
51-60	47.6	26.0	55
61-70	49.6	27.2	55
71-80	51.1	27.6	54
81-90	52.1	27.8	5[illegible]
90 +	52.6	27.8	53
Average	35.8	18.2	[illegible]

In general the average pine stand is only one-half stocked (table 6) if we assume that the best 10 percent of the stands in the uncut conditions represent full stocking. MacKinney and Chaiken[1] determined that fully stocked stands of 65-year-old loblolly pine on a 75-foot site in Virginia and North Carolina contained about 51 cords per acre. This compares with 49.6 cords for the best 60- to 70-year-old stands in table 6. The degree of stocking in the average stand remains fairly constant from age class to age class and the culmination of rapid volume increase in both fully stocked and average stands appears to be at 70 years of age.

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[1] MacKinney, A. L., and Chaiken, L. E., 1939. Volume, Yield, and Growth of Loblolly Pine in the Mid-Atlantic Coastal Region. App. For. Exp. Sta. Tech. Note 33.

VOLUME OF THE FOREST RESOURCE

The following estimates of the amount of sound wood in the Coastal Plain of Virginia in 1940 include the volume of all living trees 5.0 inches d.b.h. and larger. Saw timber consists of softwood trees 9.0 inches d.b.h. and larger and hardwood trees 13.0 inches d.b.h. and larger. Cordwood trees of both species groups range from 5.0 inches d.b.h. to sawlog size.

Volumes are measured in three forms: board feet, cords, and cubic feet. The volumes expressed in board feet include only the sawlog portion of saw-timber trees. Cordwood volumes (wood and bark) include sawlogs, the upper stems of softwood saw timber, and the sound stems of cordwood trees. Cubic-foot volumes do not include bark, otherwise the basis of estimate is the same as for cordwood. The sound volume in cull trees and the upper stems and limbs of hardwood saw timber is shown in cords in figure 13 and table 29 and in cubic feet in table 32, to provide an estimate of the total volume of sound wood.

The softwood species group includes loblolly, shortleaf, Virginia, and pond pines, cypress, Atlantic white-cedar, and redcedar. There is a very small quantity of pond pine and for this reason it is combined with loblolly pine. The small quantity of white-cedar and redcedar is combined with cypress.

The hardwood species group includes all the hardwoods native to the region except noncommercial species such as scrub oak, blue beech, red bud, and sassafras. In the Appendix tables the red oaks and the white oaks have each been grouped into two classes, poor and good, because of quality differences in the species. Poor red oaks include black, scarlet, water, willow, and southern red, species which usually produce less high-grade material than swamp red oak, the major species in the good classification. Overcup and post oaks are of poor quality compared to swamp chestnut oak and forked-leaf white oak, although it is recognized that broad generalizations do not always apply correctly to individual trees. Tupelos include both black and water tupelo, species known to the lumber trade as blackgum and tupelo gum. All species of hickory are grouped together, no single species being particularly abundant.

Board-foot volume

In 1940 the net volume of saw timber amounted to 11.7 billion board feet by the International $\frac{1}{4}$-inch rule, which is used throughout this report unless otherwise specified. According to the Doyle rule, which is in common use throughout Virginia, the net volume was only 7.3 billion feet.

By species: Two-thirds of the saw timber is softwood, chiefly loblolly pine. As shown in figure 10 there are nearly 7 billion feet of this species alone, and it accounts for 58 percent of all the saw-timber volume. By comparison the other species appear unimportant as a source of saw timber but, in the aggregate they amount to nearly 5 billion feet, forming a significant part of the saw-timber stand. White-cedar is limited to the Dismal Swamp and the total volume is not over 8 million board feet. About 25 percent of the red oak saw timber and 88 percent of the white oak is in the more desirable species.

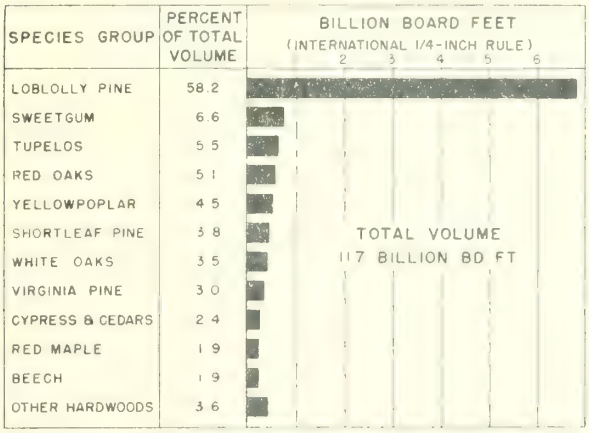


FIGURE 10 - THE VOLUME OF SAW TIMBER BY SPECIES, 1940

By forest condition: The softwood saw timber is almost entirely second growth for 92 percent is in second-growth saw-timber stands and 2 percent is in saw-timber trees scattered throughout young cordwood stands. Only 6 percent is old growth, chiefly loblolly pine.

Old growth stands are a better source of saw timber in the hardwoods, for 18 percent of the volume is in these mature forests. About two-fifths of this old-growth volume is black and water tupelo. Eighty percent of the hardwood volume is in second growth saw-timber stands, and in these sweetgum alone accounts for nearly one-fourth of the saw timber. Cordwood stands contain only 2 percent of the volume and this is chiefly sweetgum, good-quality white oak, poor-quality red oak, and yellowpoplar.

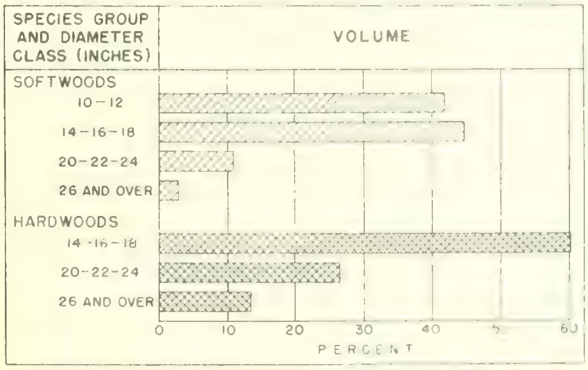


FIGURE 11- DISTRIBUTION OF NET BOARD-FOOT VOLUME BY SPECIES GROUP AND DIAMETER CLASS, 1940.

By diameter class: Nearly 15 percent of the softwood saw-timber volume is in trees larger than 19.0 inches d.b.h. and nearly 60 percent is in trees above 13.0 inches in diameter (fig. 11). This is a rather high proportionate volume in large trees, since most of the stands are less than 60 years old. Rapid growth on good sites is a contributing factor but it also indicates that the pressure for softwood saw timber was not excessive up to 1940.

A different relationship exists in the hardwoods because they are not considered saw timber below 13.0 inches in diameter. Forty percent of the volume is in trees over 19.0 inches d.b.h. About one-half of the volume in these larger trees is composed of sweetgum, tupelos, and yellowpoplar.

Volumes-per-acre: Commercial utilization of the saw timber depends, in part, upon the distribution of the board-foot volume on the forest land. In practice sawmill operators usually must be assured of a certain minimum total volume before they will set up a mill, but this really means that the stand-per-acre on the land within economical hauling distance must be great enough to provide the required quantity of logs. Small portable mills frequently log stands averaging only a few hundred feet per acre, but most operators prefer at least 2,000 feet.

Most of the board-foot volume in the saw-timber conditions is operable. Stands stocked with less than 2,000 feet per acre occupy 28 percent of the land in the softwood types but they contain only 7 percent of the saw timber, leaving 93 percent of the softwood volume concentrated on 72 percent of the land averaging more than 2,000 feet (fig. 12). Actually, 37 percent of the softwood volume is in stands averaging 10,000 feet and over per acre.

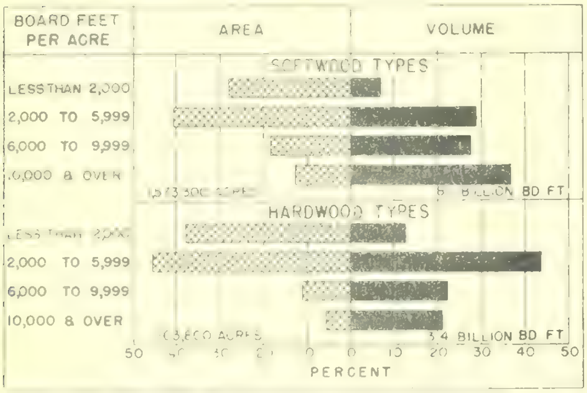


FIGURE 12 - DISTRIBUTION OF AREA AND BOARD-FOOT VOLUME (INT. 1/4-IN. RULE) IN THE SAW TIMBER CONDITIONS BY VOLUME-PER-ACRE CLASS, 1940

The hardwood volume occurs in lighter stands per acre. Stands of less than 2,000 feet occupy 38 percent of the hardwood type area and contain 13 percent of the hardwood volume. Forty-four percent of the volume is in stands of 2,000 to 6,000 feet per acre and only 21 percent is in stands of 10,000 feet and over.

About one-fourth of the total saw-timber area is stocked with more than 6,000 feet per acre, and these stands contain three-fifths of the board-foot volume.

Table 7. - Average board-foot volume[1] per acre by forest type and class of stand, 1940

Forest type	Saw-timber stands	Cordwood stands	All stands
	Bd.ft.	Bd.ft.	Bd.ft.
Loblolly pine	5,530	180	3,740
Virginia pine	2,900	130	1,570
Shortleaf pine	3,380	230	2,040
Cypress-cedar	8,340		6,310
Upland hardwoods	2,940	240	1,810
Bottom-land hdwds.	4,760	180	3,250
All types	4,630	190	3,000

[1] International $\frac{1}{4}$-inch rule.

The average volume per acre, including both saw-timber and cordwood stands, is 3,000 board feet (table 7). White-cedar saw-timber stands have the largest average volume per acre but there are only a few thousand acres left and these are being cut over rapidly. One-half of the total saw-timber area is stocked with stands of loblolly pine which average 5,530 feet per acre, ranging from an average of 3,920 in partly-cut second growth to 14,910 in old growth timber.

Cordwood Volume

The total volume of all sound trees is 60 million cords excluding culls and the upper stems and limbs of hardwood saw timber. Nearly 30 million cords are contained in the sawlog portion of saw-timber trees and 4 million cords are contained in the upper stems of softwood saw timber. Small trees below saw-timber size amount to 26 million cords. With the addition of over 8 million cords of sound usable wood in cull trees and nearly 6 million cords of wood in the upper stems and limbs of hardwoods the total amount of wood in all trees is 74 million cords (table 29, Appendix).

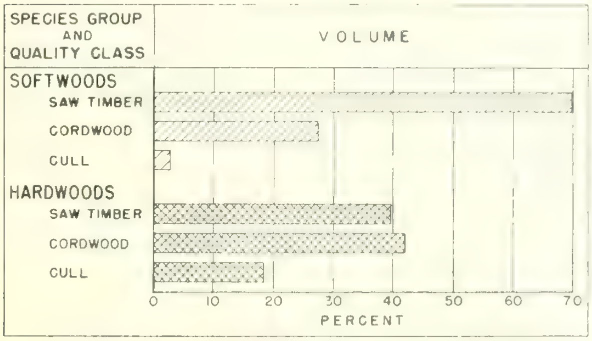


FIGURE 13- DISTRIBUTION OF TOTAL CORDWOOD VOLUME BY TREE-QUALITY CLASS, 1940.

By quality class: Forty-[illegible] of the total cord wood volume is softwood, [illegible] 34.1 million cords. There are 23.8 million cords in saw-timber trees; 19.5 million in sawlogs and 4.3 million in the upper stems. Young cord wood trees contain 9.3 million cords and cull trees only one million. Eighty-two percent of the total softwood volume is loblolly pine.

Fifty-four percent, 40.2 million cords, of the total cordwood volume is hardwood. Saw-timber trees contain 15.9 million cords, two-thirds in sawlogs and one-third in upper stems and limbs (table 29, Appendix). The volume of young trees, 16.9 million cords, is greater than the volume of saw-timber trees. There are 7.4 million cords of cull hardwoods, 18 percent of the entire hardwood volume and 10 percent of the total volume of sound wood in all species. Two-fifths of this cull volume is tupelo and red maple, both suitable for certain kinds of pulp. Nineteen percent of the total hardwood volume is sweet gum, but the tupelos, white oaks, red oaks, and yellowpoplar also account for a large proportion of the cordwood volume.

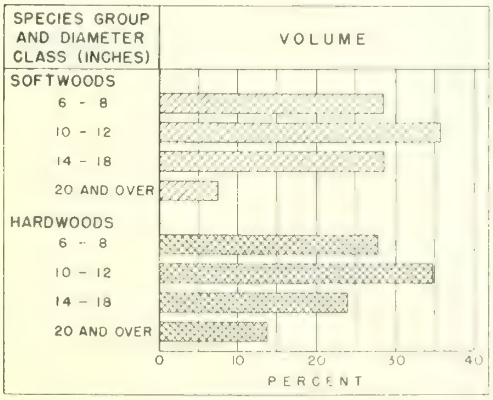


FIGURE 14- DISTRIBUTION OF NET CORDWOOD VOLUME IN SOUND TREES BY DIAMETER CLASS, 1940.

By diameter class: The distribution by diameter class of the volume in all sound trees, 60 million cords, is indicated in figure 14. There is a close similarity in volume distribution between species groups, the chief difference occurring in the largest diameter class of the hardwoods. This is because of the rather high proportion of old growth in the bottom-land hardwoods type. Including all species there are 16.8 million cords in the 6- and 8-inch class, 21.2 million cords in the 10- and 12-inch class, 15.9 million in the 14-, 16-, and 18-inch class, and 6.1 million in the 20-inch and over class.

Table 8. - Average cordwood volume per acre by forest type and class of stand, 1940

Forest type	Saw-timber stands	Cordwood stands	All stands
	Cords	Cords	Cords
Loblolly pine	23.6	4.7	17.3
Virginia pine	16.9	4.4	10.9
Shortleaf pine	18.8	6.8	13.4
Cypress-cedar	32.2	0.1	24.4
Upland hardwoods	16.1	7.0	12.3
Bottom-land hdwds.	21.7	5.4	15.8
All types	21.2	5.2	15.3

Volume-per-acre: The average volume of wood per acre, excluding culls and upper stems and limbs of hardwoods, is 15.3 cords. This is the average of all forest types and conditions, including reproduction.

Saw-timber stands average 21.2 cords per acre. Average volumes range from 53.3 cords per acre in old growth cypress-cedar to 13.7 cords in partly cut stands of upland hardwoods. Loblolly pine saw timber averages 23.6 cords per acre over 1.3 million acres, one-third of all the forest land.

Cordwood stands have an average volume of only 5.2 cords per acre, representing the stand on 1.4 million acres of land. The extremely small volume in the cypress-cedar type is not significant because less than 10,000 acres are involved.

Cubic-Foot Volume

The net volume of sound wood, without bark, in all trees 5.0 inches d.b.h. and larger is summarized in cubic feet in table 9. Forty-eight percent of the volume is softwood and 52 percent hardwood. Of the softwood volume, 71 percent is in saw-timber trees, 26 percent is in cordwood trees, and only 3 percent is in cull trees. By contrast only 40 percent of the hardwood volume is in saw-timber trees, 41 percent is in cordwood trees, and 19 percent is in cull trees.

Table 9. - Net cubic foot volume of all sound wood by species group and quality class, 1940

Quality class	Softwoods	Hardwoods	All species	
	M cu. ft.	M cu. ft.	M cu. ft.	Percent
Saw timber:				
Sawlogs	1,368,910	676,600	2,045,510	41.9
Upper stems	297,260	342,340	639,600	13.1
Total	1,666,170	1,018,940	2,685,110	55.0
Cordwood	609,490	1,039,380	1,648,870	33.8
Cull trees	68,670	478,590	547,260	11.2
All classes	2,344,330	2,536,910	4,881,240	100.0

Poles

A great number of pine poles and piles are cut each year from the forests of coastal Virginia. Many are used locally in telephone and power lines and in docks, bridges, shipyards and foundations, while others are shipped to the large cities of the northeast. The Forest Survey did not tally the number of pine trees suitable for piles, but an estimate was made of the number of trees suitable for poles (table 33, Appendix). The length-class distribution of the estimated 21 million poles is indicated in figure 15. Short poles predominate, but nearly 20 percent of the pole stand will make poles 35 feet or over in length. This is an unusually high proportion.

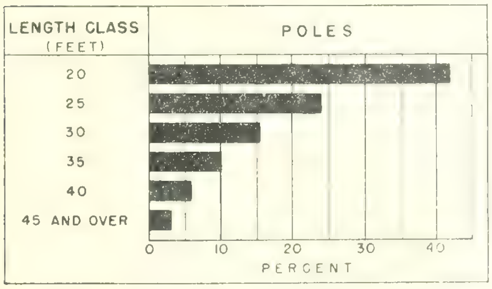


FIGURE 15 - DISTRIBUTION OF PINE POLES BY LENGTH CLASS, 1940.

THE PRIMARY FOREST INDUSTRIES

The forests of coastal Virginia provide raw material for a great variety of primary wood processing plants. Sawmills predominate but 88 other plants manufacture veneer and packages, various kinds of cooperage, excelsior, pulp and paper, handles, and other products. Large quantities of fuel wood and fence posts are cut each year, as well as poles, piles, and hewn crossties. About 2 million cords of sound wood were cut from the forest in 1940 for conversion into these various products, and their harvesting and manufacture provided nearly 17,000 man-years of employment.

The Lumber Industry

On the basis of a mill-to-mill canvass made in 1941 throughout Virginia, the 567 sawmills operating in the Coastal Plain cut 46 percent of all the lumber produced in the State. In doing so they accounted for 66 percent of the drain upon the saw-timber growing stock and provided 28 percent of the woods and plant employment in the forest industries of the coastal area. Small sawmills are the rule, however, for 506 of the mills had a cutting capacity of less than 10,000 board feet per day and 49 had a capacity of only 10,000 to 20,000 feet. Only 12 mills could normally cut more than 20,000 feet per day, but 3 of these had a combined productive capacity of 215,000 board feet each 8 hours. Altogether the 567 mills cut 492 million feet, 85 percent softwoods and 15 percent hardwoods. In 1941 sawmills cut about 585 million feet of lumber, nearly a 20 percent increase over the previous year.

Table 10. - Lumber production by capacity class of sawmill and species group, 1940

Rated capacity in 8 hours	Mills	Softwoods	Hardwoods	All species groups	
M bd. ft.	Number	M bd. ft.	M bd. ft.	M bd. ft.	Percent
1-9	506	241,200	33,800	275,000	55.9
10-19	49	76,500	10,400	86,900	17.7
20-39	9	42,600	4,400	47,000	9.5
40 & over	3	58,000	25,300	83,300	16.9
All mills	567	418,300	73,900	492,200	100.0

Mills of 1-9 M capacity: The 506 small sawmills (table 10) produced 56 percent of the lumber. They were responsible for almost the entire 20 million feet of lumber cut from Virginia pine and they also cut more oak than the larger mills, accounting for 20 of the 26 million feet.

Three-fourths of these mills changed location an average of three times during 1940. The other one-fourth could be moved but for various reasons they remain in the same place year after year. Forty-eight percent of the mills used steam power, 40 percent used gasoline units, or old automobile engines, 11 percent used Diesel units, and 1 percent, only

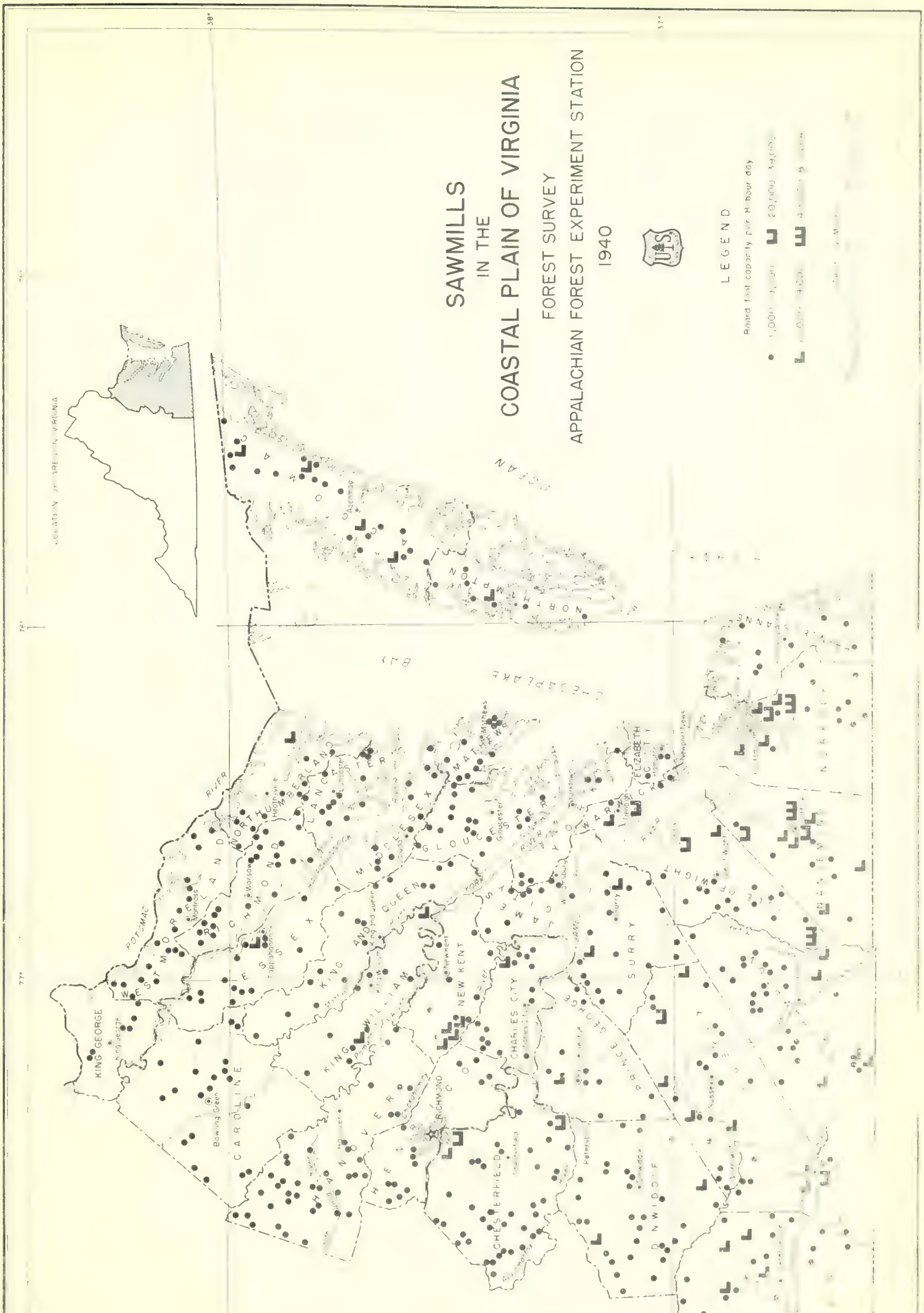

SAWMILLS
IN THE
COASTAL PLAIN OF VIRGINIA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1940
LEGEND
Board foot capacity per 8 hour day
20,000 - 39,000
KING GEORGE
WESTMORELAND
NORTHUMBERLAND
RICHMOND
LANCASTER
ESSEX
MIDDLESEX
KING AND QUEEN
MATHEWS
GLOUCESTER
KING WILLIAM
NEW KENT
HANOVER
HENRICO
CAROLINE
CHARLES CITY
JAMES CITY
YORK
WARWICK
ELIZABETH CITY
CHESTERFIELD
PRINCE GEORGE
SURRY
ISLE OF WIGHT
NANSEMOND
NORFOLK
PRINCESS ANNE
DINWIDDIE
ACCOMAC
NORTHAMPTON
POTOMAC RIVER
CHESAPEAKE BAY
OCEAN
RICHMOND
Bowling Green
Montross
Warsaw
Tappahannock
New Kent
Surry
38°
37°
36°
77°
76°
78°

FIGURE 16

four mills, used electric power (table 34, Appendix). Practically all of the mills had belt feed, although four had an auxiliary steam feed to step-up their production. All of the mills used circular saws, a very few had resaws, 35 percent had edgers, 8 percent had trimmers, 12 percent had planers, and only 3 mills operated dry kilns. Rough green lumber, much of the softwood cut 2 inches thick, was the major product.

Table 11. - Source of sawlogs, in percent, at mills of four capacity classes, 1940

Source	Rated capacity M bd. ft. in 8 hours				All mills
	1-9	10-19	20-39	40+	
Land owned	9	10	10	60	18
Stumpage purchased	67	51	61	26	56
Logs purchased	4	23	29	14	12
Contract sawing	18	16	-	-	13
Custom sawing	2	negl.	-	-	1

About two-thirds of the sawlogs used by these small mills were purchased as stumpage (table 11) and one-fifth of the logs were sawed under contract at a fixed rate per thousand feet of lumber produced. Custom sawing was relatively unimportant and very few logs were purchased delivered at the mill, but it is somewhat unusual to find that small mill operators obtained nearly 10 percent of their sawlogs from their own land.

Most of the logging was accomplished through the use of animal power in the woods, and trucks on the highway hauls. Animals were used for bunching on 98 percent of the logging operations, with mules twice as numerous as horses (table 35, Appendix). Only seven operators used tractors for bunching although five used them for skidding direct to the mill. High wheels were used for the short haul, which was either directly to the mill or to a loading point, on 94 percent of the operations. Here again animals were the favored motive force, with tractors in use on only 20 logging jobs. The average length of the short haul was one-third of a mile. Logs were hauled more than one mile to the mill on only 15 percent of the operations. Practically all of this hauling was by [illegible] one-way distance of six miles. [illegible] average operation 6 men were employed in the woods and 6 in the sawmill.

Mills of 10-19 M capacity: Thirty-four of the 49 mills in this capacity class were located south of the James River. The total cut of all these mills was about 87 million feet of lumber, 18 percent of the total. The softwood was chiefly loblolly pine and over one-half of the 10 million feet of hardwood was sweetgum, black tupelo, and yellowpoplar, the remainder was chiefly oak.

About 20 of these mills changed location during the year, moving an average of 4 times. Steam powered three-fourths of the mills, the rest used Diesel and gasoline units. A majority had belt feed, but 16 had auxiliary steam and 3 had the standard shotgun feed. Circular saws were in use at 43 of the mills and 6 used band saws. A few mills had resaws, edgers were standard equipment, but only one-third used trimmers and planers. Dry kilns were operated at seven mills.

Operators of these mills purchased about one-half of their sawlogs as stumpage and bought nearly one-fourth delivered at the mill yard. The rest were obtained from land they owned and from stumpage logged and sawed under contract. Animal logging was most common, as 92 percent of the mills used animals for bunching and all of them used high wheels and animals for the short haul which averaged two-fifths of a mile at two-thirds of the mills. A few operators skidded directly to the mill with small gasoline skidders. Logs were hauled an average distance of 10 miles to one-half the mills. Trucks were used on all these operations, supplementing railroad haul in two instances. Employment at the average mills of this size-class was provided to 11 men in the woods and 13 in the sawmill.

Mills of 20-39 M capacity: Eight of the nine mills in this class were located south of the James River. Altogether they cut 47 million board feet of lumber, nearly 10 percent of the total production. Ninety percent of the lumber was softwood, chiefly loblolly pine, and the remaining hardwood was mostly yellowpoplar, oak, and sweetgum.

These mills are stationary. Eight of them were steam powered and had shotgun or auxiliary steam feeds. The one electric mill had a belt feed. Bandsaws, edgers, and trimmers were the usual equipment but only four mills were equipped with planers, and only six had dry kilns.

Six-tenths of the sawlogs for these mills were purchased as stumpage, three-tenths were purchased delivered at the mill, and one-tenth were obtained from land owned by the mill operators. Animals were used for bunching logs on most operations but tractors were used in at least two instances. Six operators used high wheels pulled by animals or tractors on short hauls averaging one-half mile and trucks were used to haul the logs an average distance of 14 miles from the woods to the sawmill. Thirty-seven men worked on the average woods operation and 34 were used in the mill.

Mills of 40 M and over capacity: Three of the 4 mills in the State with a capacity of 40,000 or more feet per day are located in the Costal Plain, in Isle of Wight, Nansemond, and Norfolk counties. Capacities of these three mills ranged from 40,000 to 100,000 board feet each 8 hours. They cut 83 million feet in 1940, 17 percent of the total lumber cut. Seventy percent of the production was softwood and 30 percent hardwood. They cut three-fourths of the cypress and white-cedar produced in the area as well as most of the black and water tupelo and soft maple.

These mills were all steam powered, with shotgun feeds, band saws, and a full complement of equipment for making graded, kiln-dried lumber of good quality. Sixty percent of the sawlogs were obtained from company-owned lands, 26 percent were purchased stumpage, and 14 percent were bought on the mill yard. All three companies obtained sawlogs from the Dismal Swamp and two own large acreages of forest land in the Swamp in Virginia and North Carolina. Steam skidders were used in logging the Swamp, and tractors and mules were used on the drier ground. Trucks hauled all the sawlogs for one mill and part of the logs for the other two. These two larger mills were supplied by logging railroads and one also obtained logs by barge. The average haul for the three mills was 48 miles. The number of employees varies widely between individual operations, but averages 445 for both woods and mill, exclusive of the planing-mill employment.

Lumber cut by tree-diameter class: Numerous studies in various timber types and forest regions have demonstrated that logging and milling costs can be reduced and lumber values can be increased by restricting the cut to the trees of larger diameter, a practice that will generally leave a growing stock of young small trees as a basis for future operations.

Table 12. - Distribution of lumber cut and total saw-timber stand by species group and tree-diameter class, 1940

Species group and diameter class (inches)	Lumber cut	Saw-timber stand
	Percent	Percent
Softwoods:		
6-8	1	-
10-12	[illegible]	41
14-16-18	44	45
20+	41	14
Total	100	100
Hardwoods:		
10-12	[illegible]	
14-16-18	[illegible]	60
20+	[illegible]	40
Total	100	100

Studies made on the cutting areas of about one-half the sawmills indicate that the lumber industry was obtaining a large proportion of its cut from the larger trees, as 85 percent of the softwood was cut from trees over 13.0 inches in diameter and 63 percent of the hardwood was cut from trees over 19.0 inches in diameter (table 12). The proportionate cut from the smaller trees was appreciably less than their occurrence in the saw-timber stand, resulting, as far as the lumber industry is concerned, in a gradual increase in this class of growing stock. On the other hand, the proportionate cut from trees above 19.0 inches in diameter in both the softwoods and hardwoods was in excess of the proportionate saw-timber volume in these larger trees. This is not necessarily bad practice but it does tend to reduce the average diameter of saw timber by causing a gradual reduction in the quantity of large-sized growing stock. In less than 10 years the volume recruited from the smaller trees will begin to compensate for this overcutting.

Employment in lumber industry: In 1940 over 9,000 people were employed by the lumber industry, not including those working in dry kilns and planing mills (table 13). Only the larger mills provided full-time employment, however, for the mill cutting less than 10,000 board feet per day operated an average of only 101 days and the mills cutting 10,000 to 19,000 board feet averaged 164 days. The total employment in woods and sawmills, exclusive of dry kilns and planing mills, amounted to 1.2 million man-days, equivalent to 4,800 man-years of 260 days each.

Table 13. - Employment in the lumber industry by capacity class of sawmill, 1940

Item	Rated capacity M bd. ft. in 8 hours			
	1-9	10-19	20-39	40+
	Number	Number	Number	Number
Avg. operating time:				
Shifts or days	101	164	223	389
Avg. number employees:				
On logging operation	6	11	37	267
In sawmill only	6	13	34	178
Total	12	24	71	445
Total employees:[1/]				
In woods	3,036	529	333	801
In sawmills	3,187	613	301	535
Total	6,223	1,142	634	1,336
Man-hours per 1,000 bd. ft.:				
In woods	9.5	9.1	14.3	19.2
In sawmill	10.3	10.5	12.2	12.2
Rough lumber	19.8	19.6	26.5	31.4
Add for drying & finishing	6.7	5.5	7.0	9.0
Total	26.5	25.1	33.5	40.4
Total man-days:[2/]				
In woods	316,200	90,100	72,200	90,900
In sawmills only	354,100	114,100	71,700	127,000
Total	670,300	204,200	143,900	217,900

[1/] Total employees 9,335.

[2/] Total man-days 1,236,300, equivalent to 4,800 man-years of 260 days.

Two-thirds of the workers were employed at the small mills cutting less than 10,000 board feet per day. These mills produced 1,000 feet of rough lumber with about 20 man-hours of labor for logging and milling and the limited number that made finished lumber used an additional 6.7 man-hours for drying and planing. Labor requirements were about the same in the mills of the 10,000 to 19,000 capacity class. More labor was required at the larger mills because logging conditions on the largest operations were difficult, the logs were hauled farther, most of the lumber was kiln dried, and a greater variety of carefully finished materials were produced.

Other Forest Products

More wood was used in nonlumber plants and for poles, piles, hewn crossties, fuel wood, and fence posts than for lumber. Eighty-eight plants, in addition to sawmills, were using wood as a primary raw material

Table [illegible]. Production in the nonlumber forest industries, 1940

Commodity	Plants	Produced or used
	Number	M bd. ft.
Veneer	9	23,100
		M cords
Nail kegs	42	76
Potato barrels	8	[illegible]
Misc. cooperage	[illegible]	6
Excelsior	1[illegible]	[illegible]
Pulpwood	4	424
Handles	[illegible]	1
Misc. mfg. prod. 1/	7	-
Fuel wood	-	1,[illegible]
		M pieces
Hewn crossties		[illegible]
Poles and piles		[illegible]
Fence posts	-	1,[illegible]
Total	8[illegible]	-

1/Includes 3 wood-turning plants, 2 shingle mills, 1 box factory, 1 shuttle block mill.

in 1940. The four pulp mills at West Point, Hopewell, Franklin, and Jarratt were the largest but the most numerous were the 37 mills making nail keg staves (table 14). Other plants made excelsior, potato barrels, veneer, handles, and miscellaneous cooperage, while still others made products varying from wooden buttons to dogwood bearings for textile machinery. Altogether about 615,000 cords of wood were used in these plants and 1.3 million cords were used for fuel wood and other rough products. This was about 600,000 cords more than was used by the lumber industry.

Veneer: Nine veneer plants were in operation in 1940 but two of these made furniture veneers from imported woods and will not be considered further in this discussion. Of the remaining seven, one made furniture veneer, one made shipping cases for radios, refrigerators, and similar products, and five made fruit and vegetable baskets. These seven plants used 23 million board feet of logs measured by the International $\frac{1}{4}$-inch rule, or 18 million feet by the Doyle rule. About one-half of this wood was sweetgum, one-third was black and water tupelo, and the rest was chiefly yellowpoplar, loblolly pine, elm, cypress, and sycamore. One-third of the wood was cut from trees in the 14 , 16 , and 18-inch diameter classes and the rest came from larger trees. All of the veneer bolts were purchased delivered on the yard, one operator paying $15.00 per thousand feet Doyle scale for sweetgum and $25.00 for yellowpoplar.

Nearly 1,300 men were employed at these veneer plants which operated an average of 256 days in 1940. For each 1,000 board feet of logs consumed 119 man hours were required in the mill to make the veneer and fabricate the finished cases and baskets. This contrasts with about 15 man-hours to log and deliver 1,000 board feet of veneer bolts or logs to the mill. Total woods employment amounted to 28,600 man-days.

Nail keg staves: Thirty-seven of the 42 plants making nail keg staves in Virginia in 1940 were located in the Coastal Plain, chiefly in Sussex, Southampton, and Surry counties (fig. 17). They used about 76,000 cords of wood, 98 percent loblolly pine and 2 percent yellowpoplar.

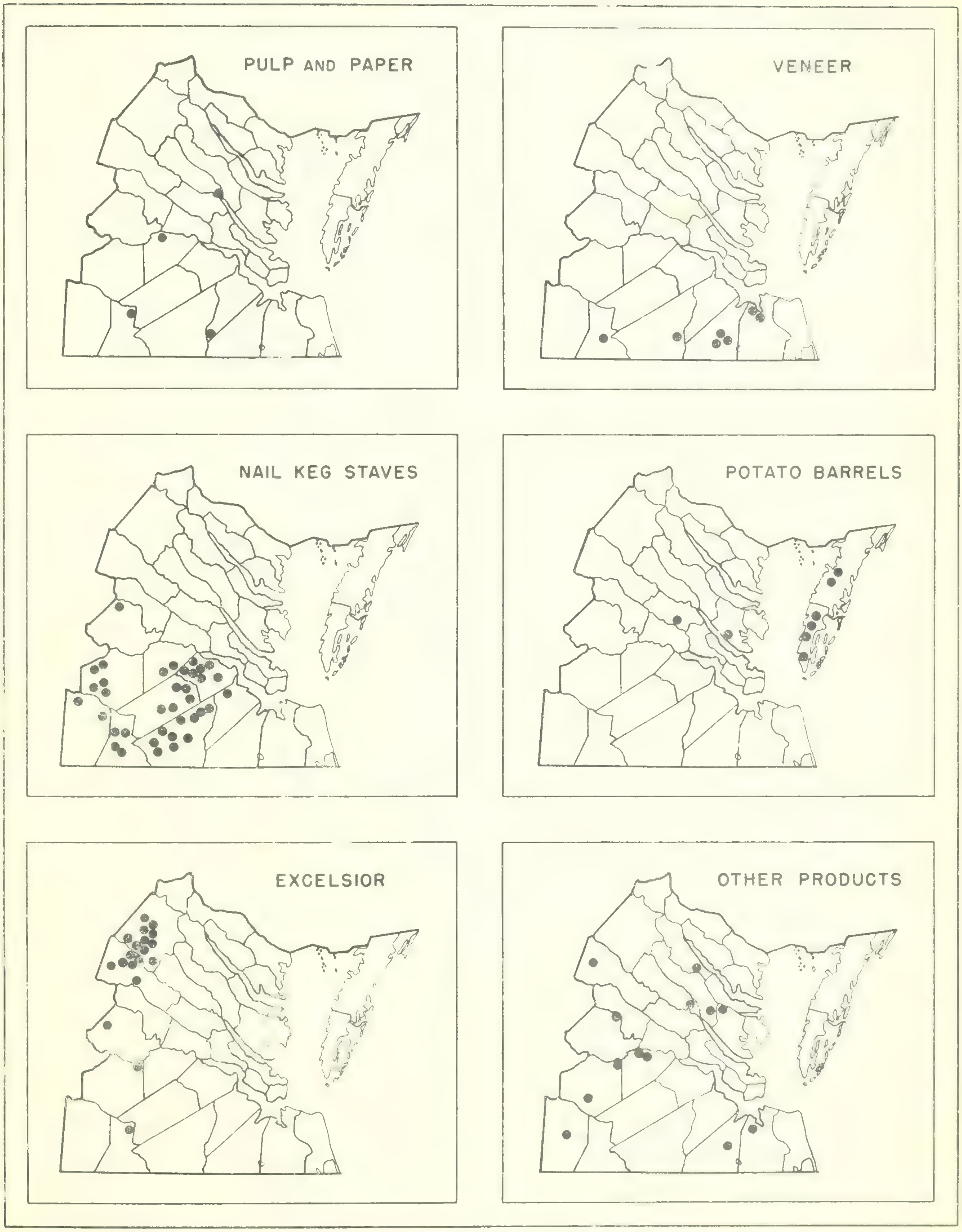


FIGURE 17 - APPROXIMATE LOCATION OF PRIMARY NONLUMBER FOREST PRODUCTS PLANTS, 1940.

Practically all of this wood was purchased as standing timber with payment on a lump sum basis. The stave operators cruise prospective tracts in terms of bundles and base their offer upon maximum stumpage values of 10 to 12.5 cents per bundle, equivalent to $1.60 to $2.00 per standard cord. Trees 8, 10, and 12 inches in diameter made up most of the cut, although the range of utilization extended from 6 to 20 inches. The timber used is of high quality, since the staves must be clear.

The most common lengths of staves are 17, 18, and 18½ inches, although they range in length from 15 to 21 inches. One standard cord of wood will make about 16 bundles of staves, or about 160 kegs. At this rate the 37 plants operating in 1940 made enough staves for 12 million kegs. These staves are shipped by rail, 850 to 1,000 bundles per car, to cooperage shops at the large steel mills where they are assembled with heading made in other plants. Most of the staves manufactured in Virginia are sent to Pennsylvania.

Most mills employ about 14 men, 4 in the woods and 10 in the mill. They usually work on a group-task basis with 125 to 150 pens set as a day's task, which they usually accomplish in less than 8 hours. Woods workers at each mill consist of one pair of fallers, one buncher, and one cart driver. Timber is skidded in long lengths and logging is at the rate of one standard cord every 3.9 man-hours. Mill workers cut staves at the rate of 14 bundles every 8 man-hours. Altogether, about 160 men were employed in the woods and 366 at the mills. In 1940 they worked an average of 229 days for a total of 121,100 man-days.

Potato barrels: Great quantities of Irish potatoes are grown on the Eastern Shore in Accomac and Northampton counties and many of them are marketed in barrels made in local cooperage plants. In 1940 there were four potato barrel plants in Northampton, two in Accomac, and one each in Gloucester and New Kent counties. They used 4,500 cords of loblolly pine, most of it cut from 10- and 12-inch trees. Six of the plants did their own logging and bought standing timber. The wood was hauled in 15-foot log lengths an average distance of 4 miles to the mills where it was cut into stave lengths of 28.5 inches. Two operators purchased 180 cubic-foot units of 5-foot wood delivered at the mill yard. Practically all of the timber was obtained from farm woodland.

The average plant gave employment to about 14 men, 8 in the mill and 6 in the woods. Operation is seasonal and the 65 plant employees and 50 woods workers were employed, on the average, only 54 days in 1940. For each cord of wood consumed, 6.3 man-hours of labor were expended in the mill and 5.0 in the woods, altogether 6,400 man-days.

Miscellaneous cooperage: These plants include a nail keg heading mill at Petersburg, a tight stave mill at Lawrenceville, and a tobacco hogshead mill at Cologne in King and Queen county. Altogether they used 5,800 standard cords of wood with the nail keg heading made from loblolly and shortleaf pine and yellowpoplar, the tight staves made from white oak, and the tobacco staves and heading made from loblolly and shortleaf pines. The pine and yellowpoplar were cut by local farmers and delivered [illegible] the basis of 180 cubic foot units. The operator of the tight stave mill bought stumpage from farmers and did his own logging.

[illegible] days, altogether 6,700 man-days. Almost as many men worked in the woods, for [illegible].

Excelsior: Virginia contains more excelsoir plants than any other state in the Nation. Nineteen of the 20 operating in Virginia in 1940 were located in this survey unit, particularly in Caroline and Hanover counties. They used 30,300 standard cords of peeled pine, chiefly loblolly equivalent to 41,000 cords of rough wood. Most of the wood was purchased from farmers and contractors for about $8.00 per unit of 180 cubic feet of peeled wood delivered at the mill, after an average haul of 10 miles. The individual bolts are cut five feet long and those four to six inches in diameter are preferred. The average plant consumed about five units of wood per day or 1,200 units per year. One unit of wood yields 1.25 to 1.5 tons of excelsior, therefore the total production in 1940 was about 30,000 tons.

The number of employees at excelsior mills varied from 4 to 12, but averaged about 7. The plants operating in 1940 gave employment to 130 men for an average of 233 days. Woods employment was distributed among many farmers, how many is not known. It takes about 12 hours to cut and deliver a standard cord of excelsoir wood and at this rate 58,300 man days of woods employment were provided.

Pulp and paper: Sulphate pulp and kraft paper are manufactured by three large pulp and paper mills located at Franklin, Hopewell, and West Point. With a total capacity of 825 tons of sulphate pulp each 24 hours they account for three fourths of the sulphate and two-fifths of the total pulp capacity in Virginia. A fourth mill located at Jarratt makes 200 tons of groundwood pulp and 500,000 square feet of insulating board each 24 hours.

In 1940 these four mills consumed 423,700 standard cords of wood, including 31,200 cords of slabs purchased from sawmills. The round wood, 392,500 cords, was 80 percent loblolly and shortleaf pine and 20 percent Virginia pine. Less than 5 percent of the wood was obtained from thinnings on company owned land and the remainder was purchased. An estimated 60 percent was cut from farm woodlands. Approximately 25 percent of the pulpwood was cut from trees 6 and 8 inches in diameter, 59 percent was cut from 10- and 12-inch trees, and 16 percent came from larger trees. Pulpwood was brought into the mills by truck, railroad, and barge. The maximum length of haul was about 35 miles for trucks and 100 miles for barges and railroads. These long hauls give each mill a large operating territory and only a very small part of the forest land in the unit is not tributary to a pulp mill.

Over 1,900 employees worked at the four mills which operated an average of 348 days in 1940. For each cord of wood made into pulp and paper 12.6 man-hours of labor were provided in the mills and an estimated 10 man-hours in the woods. The total woods employment amounted to 476,400 man-days, equivalent to 348 days of work for 1,400 men. Actually, many more pulpwood cutters worked a smaller number of days.

Handles: Three plants used about 1,000 cords of ash and 300 cords of hickory in the manufacture of handle blanks, tool handles, and baseball bats. Thirty-nine men were employed at these three mills where they worked an average of 166 days. Handle manufacture is a labor-consuming process and 49 man-hours were expended for each cord of wood consumed. Logging ash also takes considerable time because the trees are of scattered occurrence in mixture with other species. On one of the operations woods labor amounted to 11.3 man hours per cord, and on this basis 1,200 man days of woods employment were provided.

Miscellaneous manufacturing plants: Three wood-turning plants, 2 shingle mills, 1 box factory, and 1 shuttle block mill are included in this group. The turning plants made buttons and textile machine bearings of dogwood and paper roll plugs of pine, the shingle mills used white-cedar from the Dismal Swamp, the box factory made asparagus crates of pine, and the shuttle blocks were made of dogwood. Altogether about 170 cords of pine, 100 cords of dogwood and 1.4 million board feet of white-cedar were used. Almost 100 men worked in the plants and the estimated employment was 25,400 man-days in the mills and 6,800 man-days in the woods.

Fuel wood: In 1940 the total amount of fuel wood used was 1.2 million cords. This estimate represents the total fuel wood consumed by rural farm, rural nonfarm, small town, and urban families, and that used for curing tobacco. The rural use was obtained by contacting a proportion of the families in each rural category, according to a definite sampling procedure, to arrive at average consumption figures which were applied to the total number of families in each class. In the small towns the families were sampled and in addition the wood-yard sales were obtained. Fuel wood use in the larger cities was based directly upon sales reported by 73 wood yards with additions for the wood sold in town by farmers. The amount of wood used to cure 75,000 pounds of tobacco provided a factor of 2.87 standard cords per 1,000 pounds which was applied to the total production of tobacco. These methods do not give an exact measure of the fuel wood consumption but the results are the best obtainable with the funds and time available.

According to these estimates farm families used 715,000 standard cords, small-town families used 222,000, rural nonfarm families used 186,000, urban families used 33,000, and curing tobacco required 23,000 cords. The average farm family used 13.7 cords, the average rural nonfarm family used 7.8 cords, and the average small-town family used 5.5 cords. Fifty-five percent of all the fuel wood used was pine, and 45 percent was hardwood, chiefly oak. About 28 percent was slabwood obtained from sawmills, and 38 percent was cull and dead trees and topwood, leaving only 36 percent, 421,000 cords, which came from sound trees. Exclusive of the work involved in obtaining slabwood, about 1.3 million man-days of labor were required to produce the year's supply of wood.

Hewn crossties: The 275,000 hewn crossties produced in this survey unit in 1940 were one-half of all those cut in Virginia. Tie yards at Petersburg, Richmond, Fredericksburg, and Tappahannock purchased 137,000 ties for treatment at the wood-preserving plant at Massaponax, outside the unit in Spotsylvania. Other tie yards in Doswell, Richmond, Kilmarnock, Ayletts, and Petersburg purchased 90,000 and 27,000 were purchased by five railroads. All of these ties were oak for which one railroad paid the following prices F.O.B. shipping point: class 1 - 35 cents, class 2 - 45 cents, class 3 - 55 cents, class 4 - 75 cents, and class 5 - 90 cents. This same railroad purchased the following proportions of the different classes: class 1 - 5 percent, class 2 - 11 percent, class 3 - 15 percent, class 4 - 19 percent, and class 5 - 50 percent.

About 21,000 crossties were used in logging railroads, chiefly those operating in the Dismal Swamp. One-third of these were oak, one-third pine, and the rest cypress, cedar, black and water tupelos. All of these logging ties were cut from trees under 13.0 inches in diameter. About 48,100 man-days of labor were required to cut both the commercial and logging ties.

Poles and piles: About 106,000 poles and piles were cut from the forests of eastern Virginia in 1940. Three percent of them were trap stakes, 27 percent were poles, and 70 percent were piles. Pine trap stakes are used by fishermen to support nets in the water. They are from 40 to 85 feet long and from 5 to 10 inches in diameter, peeled, with the exception of the lower 5 feet. Many shorter and smaller stakes were also used but they are not included in this estimate because they are cut in small quantities all along the coast by fishermen.

Table 15. Production of pine poles and piles by length class, 1940

Length class	Poles	Piles
Feet	Percent	Percent
20 - 25	22	14
30 - 35	52	16
40 - 45	23	25
50 - 55	2	24
60 - 65	1	13
70 & over		8
Total	100	100

Practically all of the poles were purchased by creosoting companies. Only a few thousand poles were obtained directly by railroad companies. All of the poles were pine and over one-half of them were 30 to 35 feet long (table 15).

The broken and extensive shoreline of coastal Virginia and the shipbuilding and seaport facilities of the Hampton Roads area create a local market for many piles. Also, this forest area, with the Eastern Shore of Maryland, is within easy water haul of the large seaports of the northeast and is the nearest source of southern yellow pine piling. Consequently many thousand piles are cut each year. In 1940 about 74,000 were produced and practically all were pine except 1,500 oak piles and a few thousand swamp hardwood piles used in logging railroads. Two-thirds of the piles were handled by three [illegible], one at Portsmouth, one on the Eastern Shore in Accomac County, and one at West Point on the York River. The latter two shipped piles to the northeast.

The demand is for long piles, [illegible] percent of those produced were over [illegible] feet long and 20 percent were 60 feet and over. Stumpage prices vary with length, one operator paid farmers [illegible] cents per lineal foot for [illegible]-foot piles, while another paid a large lumber company [illegible] cents per foot for piling under [illegible] feet with gradual increases up to 15 cents per foot for piling 90 feet long. On this basis the stumpage value of a tree containing a 90 foot pile is $13.50 compared to a saw timber value of $[illegible] with stumpage at $10.00. These long piles are, however, very rare. Woods employment to produce the 106,000 poles and piles amounted to 43,600 man-days.

Fence posts: The estimate of fence posts used in 1940 is based upon a sample obtained from [illegible] farms ranging in size from [illegible] to 2,000 acres, distributed throughout the Coastal Plain. Posts were used on [illegible] percent of these farms and the annual number varied from [illegible] to [illegible]. Distributing the total number of posts recorded over all sample farms resulted in an average of 48 posts per farm. White oak, red and white cedars, and black locust were the most commonly used species. The average post was [illegible] feet long and [illegible] inches in diameter.

On the basis of this sample the 38,000 farms in this survey unit used [illegible] million fence posts in 1940, with [illegible] million cut from sound trees. The total volume of wood going into posts was about 21,000 cords. Nearly 22,[illegible] man-days of labor were expended in making posts, an average of less than one day per farm.

Summary of Employment

The primary forest products industries provided almost 4.5 million man-days of employment in 1940, equivalent to [illegible] man-years of 260 days each. Three-fourths of the employment was in commercial forest activities and provided a direct wage return, at 35 cents per hour, of about [illegible] million dollars. One-fourth of the labor was expended in the production of fuel wood and fence posts for domestic use, consequently the cash return was [illegible]. The lumber industry accounted for 40 percent of all commercial employment and the pulp and paper industry accounted for 35 percent.

Plant employment: In 1940 about [illegible],600 employees worked in the 6[illegible] primary forest products plants (Table 6[illegible]). Over one-half of these worked in sawmills but their average period of employment was only 110 days per year because so many of the mills were small part-time portables. Less than 2,000 people worked in the pulp and paper plants but they worked full-time and accumulated as many man-days of employment as all the sawmill employees. The veneer industry was also a significant source of employment providing practically full-time work for about 1,300 people. At 35 cents per hour the total wage income from all plant employment was 5.[illegible] million dollars. This is an average of 600 dollars per employee, but the average wage income ranged from 150 dollars in potato barrel plants to 975 dollars in the pulp and paper mills. Sawmill workers received about 400 dollars.

Table 16. - Plant employment in the primary forest industries, 1940

Commodity	Plants	Average days operated	Employment per unit of wood		Total employees	Total employment
	Number	Number	Man-hours	Unit	Number	Man-days1/
Lumber	567	110	2/ 11	MBF	4,636	666,900
Veneer & packages	7	256	119	MBF	1,295	344,600
Nail kegs	37	229	9	cord	366	83,800
Potato barrels	8	55	6	cord	65	3,600
Misc. cooperage	3	175	9	cord	36	6,700
Excelsior	19	233	6	cord	130	30,800
Pulp & Paper	4	348	15	cord	1,913	667,100
Handles	3	166	49	cord	[illegible]	7,800
Misc. mfg. prod.	7	161	42	cord	[illegible]	25,400
Total	655	124			8,577	1,835,700

1/ Man-days are of 8 hours.

2/ Only one-fourth of the lumber was kiln dried and planed at the producing mill, rough lumber provided 11 hours of employment per 1,000 board feet.

Table 17. - Woods employment in the primary forest industries, 1940

Commodity	Total employment	
	Man-days	Man-years1/
Lumber	567,400	2,190
Veneer	28,600	110
Nail kegs	37,300	140
Potato barrels	2,800	10
Misc. cooperage	5,200	20
Excelsior	58,300	220
Pulpwood	476,400	1,830
Handles	1,200	negl.
Misc. mfg. prod.	9,100	30
Fuel wood	1,271,500	4,890
Hewn crossties	48,100	190
Poles and piles	43,600	170
Fence posts	22,600	90
Total	2,571,800	9,890

1/260 man-days.

Woods employment: Cutting and hauling wood products for commercial use provided about 1.3 million man-days of employment or full-time work for 4,900 people. Cutting fuel wood and fence posts required an additional labor outlay of 1.3 million man-days distributed among most of the farmers of the unit. It is practically impossible to determine the actual number of people who obtained part of their cash income from woods work because of part-time operation, the contract system, and the practice of buying wood delivered at the mill, but the number is large because nearly 5,000 were logging for just the lumber industry. At least 2,000 people cut and hauled pulpwood, as one pulp company alone reported having 15 agents each employing 15 to 40 workers. Over 80 percent of the commercial woods employment was in the lumber and pulp industries, but the less important industries provided enough woods work to keep 1,000 people occupied the year around.

FOREST INCREMENT AND COMMODITY DRAIN IN 1940

To be permanent, the forest products industries must have, among other things, an assured supply of raw material. A major factor influencing the supply is the relation between increment of the established forest and commodity drain. This relation is discussed in succeeding pages.

Forest Increment

Forest increment, as used in this report, is the gross volume of wood produced by growth of the sound-tree growing stock. The board-foot growing stock consists of all sound softwood trees 9.0 inches d.b.h. and larger and all sound hardwood trees 13.0 inches d.b.h. and larger. The growing stock expressed in cords and subic feet includes all sound trees at least 5.0 inches d.b.h. The small trees becoming 5.0 inches or more during the year are included in cordwood and cubic-foot increment and the young softwoods and hardwoods that become of saw-timber size are included in board-foot increment. Cull trees and the upper stems and limbs of hardwood saw timber are not considered growing stock material.

Net increment is the resultant of the volume gained through growth and the volume lost through mortality. Growth is composed of the volume recruited from small trees which grow into merchantable sizes during a given period and the volume added by the increase in diameter of merchant able trees.

Table 18. - Average net increment per acre in saw-timber stands by forest type and species group, 1940

Forest type	Soft-woods	Hard woods	All species
	Bd.ft.	Bd.ft.	Bd.ft.
Loblolly pine	288	33	[illegible]
Shortleaf pine	168	[illegible]	[illegible]
Virginia pine	148	42	[illegible]
Cypress-cedars	152	[illegible]	272
Upland hardwood	31	135	166
Bottom-land hdwd.	40	211	251
All types	180	83	263

Mortality consists of the volume lost when sound trees are killed by fire, insects, disease, and wind and the volume lost through competition for light and water. This constant struggle for suitable growing space is a major cause of mortality in natural stands and a large part of the volume lost could be saved for utilization if the forest was managed for continuous crops of timber.

Net increment per acre: Species, sizes, and numbers of trees occur in a great variety of combinations on each acre of forest land and these variations cause marked differences in the net increment per acre. Grouping the stands by forest type and saw-timber or cordwood condition reduces the irregularity and makes it possible to present the average net increment per acre for stands of the same general characteristics.

Saw-timber stands occupy 2.5 million acres - 63 percent of the forest land. The average net increment per acre on this land is 263 board feet per year, two-thirds softwoods and one-third hardwoods (table 18). The loblolly pine saw-timber stands produce the most net increment, 321 board feet, and this average applies to 1.3 million acres or one-half the saw-timber area. About four-fifths of this annual increase is loblolly pine and the rest is chiefly mixed hardwoods (table 41, Appendix).

Cordwood stands occupy 1.4 million acres - 37 percent of the forest area. The average net increment per acre on this land is 0.6 of a cord or 39 cubic feet (table 19). About two fifths of the land is stocked with young loblolly pine which is growing at an average rate of 0.6 cords per acre per year. The average net increment of young, shortleaf pine stands is greater, 0.8 of a cord, but these stands occur on less than 100,000 acres. The cordwood stands of upland hardwoods rank after loblolly pine in extent and equal it in average net increment per acre.

Table 19. - Average net increment per acre in cordwood stands by forest type and species group, 1940

Forest type	Soft-woods	Hard-woods	All species	
	Cords	Cords	Cords	Cu.ft.
Loblolly pine	.53	.10	.64	[illegible]
Shortleaf pine	.65	.15	.80	48.0
Virginia pine	.61	.12	.73	33.2
Cypress-cedars				
Upland hardwoods	.12	.52	.64	51.7
Bottom-land hdwd.	.04	.34	.38	[illegible]
All types	.37	.25	.62	[illegible]

Increment of the total stand: In 1940 the increment of the forest stand was 785.5 million board feet and the mortality loss was 37 million feet, leaving a net increment of 748.6 million feet (table 20). Eighty-six percent of this board-foot increase was in saw-timber stands and the other 14 percent was in young stands containing a few saw-timber trees. Two-thirds of the net increment was softwood, chiefly loblolly pine. Ten- and 12-inch trees yielded about 30 percent of this increment, 14-, 16-, and 18-inch trees yielded 50 percent, and larger trees produced the remaining 20 percent. One-half of the net increment of hardwood saw timber was in trees less than 20.0 inches in diameter.

The net increment of all sound trees 5.0 inches d.b.h. and larger amounted to 3.1 million cords after a deduction of 229,000 cords for mortality losses. In both the softwoods and hardwoods about 30 percent of the increment occurred in cordwood stands and 70 percent occurred in saw-timber stands. The 1.8 million cords of softwood increment (table 20) was distributed by tree-diameter class in the following proportions: 6- and 8-inch trees, 18 percent; 10- and 12-inch trees, 27 percent; 14-, 16-, and 18-inch trees, 40 percent; and trees 20 inches and over, 15 percent. A larger part of the 1.3 million cords of hardwood increment was in the smaller stems as 31 percent was in 6- and 8-inch trees, 22 percent was in 10- and 12-inch trees, 32 percent was in 14-, 16-, and 18-inch trees, and 15 percent was in trees 20 inches and larger.

Table 20. - Net increment by species group and class of material, 1940

Species group	Saw Timber	All sound trees 5.0 inches d.b.h. and larger	
	M bd.ft.	Cords	M cu.ft.
Softwoods:			
Yellow pine	472,900	1,597,600	111,750
Virginia pine	33,800	193,900	12,990
Other	6,200	11,400	920
Total	512,900	1,802,900	125,660
Hardwoods:			
Oaks	78,000	520,500	32,500
Gums	117,500	552,600	35,310
Other	40,200	232,100	15,150
Total	235,700	1,305,200	82,960
All species	748,600	3,108,100	208,620

Commodity Drain

The commodity drain from the sound-tree growing stock is composed of both the material utilized and the sound usable material left in felled trees. It includes the wood cut and used within the unit and the wood shipped outside the unit, but excludes the wood brought in from the Piedmont of Virginia and from North Carolina. The drain on the sawlog portion of the trees, including both the utilized and wasted portions, is expressed in board feet, whereas the volumes given in cords and cubic feet include drain on saw timber, upper stems of sawlog-size softwoods, and small trees ranging from 5.0 inches d.b.h. to saw-timber size. The drain upon hardwood tops is not included.

Drain on saw-timber trees: In 1940 the commodity drain upon the saw-timber growing stock amounted to 501 million board feet of softwoods and 105 million feet of hardwoods, a total of 606 million board feet (table 21). Sixty-six percent of the saw-timber drain was caused by the lumber industry and 13 percent by the pulp and paper industry. Fuel wood was the next most important cause of saw-timber drain, accounting for 9 percent of the total.

Seventy-four percent of the drain was cut from loblolly and shortleaf pines, 6 percent was cut from Virginia pine and only 2 percent from cypress and white-cedar (table 42, Appendix). Hardwoods provided 18 percent of the saw-timber drain, about equally divided between the oaks and gums which include yellowpoplar.

Two-thirds of the softwood drain of saw timber was cut from trees 14 inches d.b.h. and larger and about one-half of the hardwood was cut from trees 20 inches and larger. A more detailed presentation of commodity drain by diameter class is given in table 43, Appendix.

Table 21. - Commodity drain from the sound-tree growing stock, 1940 1/

Commodity	Saw timber		All sound trees	
	Soft-woods	Hard-woods	Soft-woods	Hard-woods
	M bd.ft.	M bd.ft.	Cords	Cords
Lumber	340,400	60,400	892,100	164,100
Veneer	800	15,700	2,000	40,100
Nail kegs	19.900	300	75,000	1,500
Potato barrels	1,100		4,500	
Excelsoir	6,900	- -	38,900	
Pulpwood	75.400	900	341,800	7,300
Misc.mfg.prod.	2,100	700	8,600	2.300
Fuel wood	41,000	12,400	198,800	221,900
Hewn crossties	200	12,100	1,000	48,300
Poles & piles	12,500	1,000	35,600	2,800
Fence posts	1,000	1,100	6,500	12,200
All products	501,300	104.600	1,604,800	500,500

1/In 1941 the estimated saw-timber drain was 707 million board feet. .

Industries and domestic consumers within the unit used 592.4 million board feet of the commodity drain and 13.5 million feet were taken out of the unit. Sawmills in the Piedmont of Virginia drew 4.7 million feet from the Coastal Plain and pulp mills in North Carolina, Pennsylvania, and western Virginia obtained 7.2 million feet of saw-timber trees and 7,400 cords of smaller trees. About 1.5 million board feet of sawlogs and veneer bolts were shipped to Delaware and small quantities of stave bolts were taken to cooperage mills in Piedmont Virginia. Sawmills, veneer mills, pulp mills, stave mills, and excelsoir plants in this unit obtained about 99.4 million board feet of timber from North Carolina and Piedmont Virginia, however, so the total wood requirement of local mills and consumers, without any export to other areas, was 691.8 million board feet.

Drain on entire growing stock: Commodity drain upon the total sound-tree growing stock 5.0 inches d.b.h. and larger, including saw timber, was 2.1 million cords; 1.6 million cords of softwoods and 500,000 of hardwoods. Fifty percent was caused by the saw-timber drain of the lumber industry, 20 percent by fuel wood cutting of saw-timber and cordwood trees, and 17 percent by the pulp and paper industry which used about one-fourth cordwood and three-fourths saw-timber trees. None of the other wood products industries caused over 4 percent of the total drain. Two-thirds of all the drain was yellow pine, chiefly loblolly (table 42, Appendix). Forty-seven percent of the total drain was obtained from trees less than 13.0 inches d.b.h., 32 percent was cut from 14- to 18-inch trees, and 21 percent was cut from trees 20.0 inches d.b.h. and larger. These proportions approximate the distribution of drain in both the softwoods and hardwoods.

About 52,000 cords of the commodity drain were shipped to sawmills, veneer plants, pulp mills, and cooperage plants outside the Coastal Plain; the remainder, slightly over 2 million cords, were used locally. Nearly 284,000 cords of wood were imported from North Carolina and Piedmont Virginia chiefly for use in sawmills, veneer plants, and pulp mills. The wood brought in exceeded the wood sent out by 232,000 cords but a large part of this importation is a result of lumber and pulp companies at Suffolk and Norfolk operating their forest lands in North Carolina, rather than a scarcity of wood. If all of the wood had been cut within the unit the total community drain would have been 2.3 million cords.

Comparison of Increment with Commodity Drain

The kind and quantity of forest growing stock determines, to a large extent, the annual yield of timber that will be available for utilization under sustained-yield forest practice. If the annual yield, or net increment, exceeds the commodity drain, the growing stock will be increased by this surplus and subsequent yields will be greater. On the other hand, when drain exceeds net increment the forest growing stock is reduced and if this happens every year the forest will eventually cease to be an important resource. An over all comparison of net increment with commodity drain reveals the status of the total forest stand but a more detailed comparison by species group and diameter class provides a better basis for measuring the volume changes in the species and sizes most in demand.

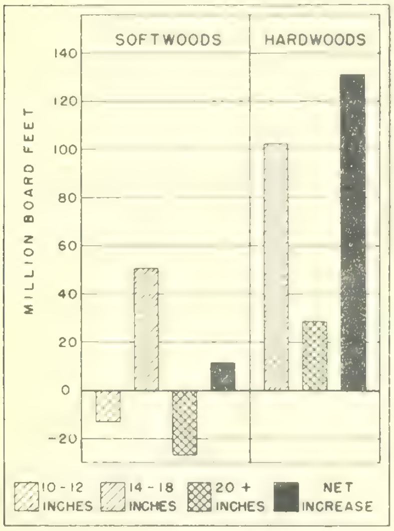


FIGURE 18-BOARD-FOOT CHANGE IN GROWING STOCK BY TREE-DIAMETER CLASS, 1940.

The following discussion applies to the situation existing in 1940. Since then the war has caused a marked increase in the use of forest products and the annual drain upon the saw-timber stand has increased by an estimated 15 to 20 percent. In some species and diameters, it is probable that drain is now materially in excess of net increment.

Comparison in board feet: In 1940 the net increment of softwoods exceeded commodity drain by a very narrow margin and the growing stock increased by only one-tenth of one percent. Both the 10- and 12-inch and the 20-inch and larger diameter-class groups were overcut, by 12.4 and 26.2 million board feet respectively, and the only increase, 50.2 million feet, was in the 14- to 18-inch trees (fig. 18).

By species group the relation was slightly different as the cypress and cedar lost volume in all diameter classes, reducing the growing stock about 2 percent. Virginia pine was overcut by 5.3 million board feet in the 10- and 12-inch classes, resulting in a one percent reduction in growing stock, in spite of an increase in the volume of larger trees.

The yellow pines, with a 49.2 million-foot increase in the 14- to 18-inch classes to counteract the volume losses in the other diameters, increased in volume by 21.6 million board feet, a gain of less than three-tenths of one percent.

In the hardwoods the net board-foot increment was more than twice the commodity drain, the net increase in growing stock amounting to 131.1 million board feet, 3.4 percent. All three species groups - oaks, gums, and other hardwoods - increased in volume in both the 14 to 18 and 20-inch and larger diameter groups, but only one-fifth of the volume increase was in the larger trees.

Comparison in cords: The net increment of the entire sound-tree growing stock 5.0 inches d.b.h. and larger exceeded the commodity drain by one million cords (table 49, Appendix), increasing the softwood growing stock by 198,100 cords and the hardwood growing stock by 804,700 cords. All species groups increased in volume except cypress and cedar which suffered a total loss of 24,600 cords.

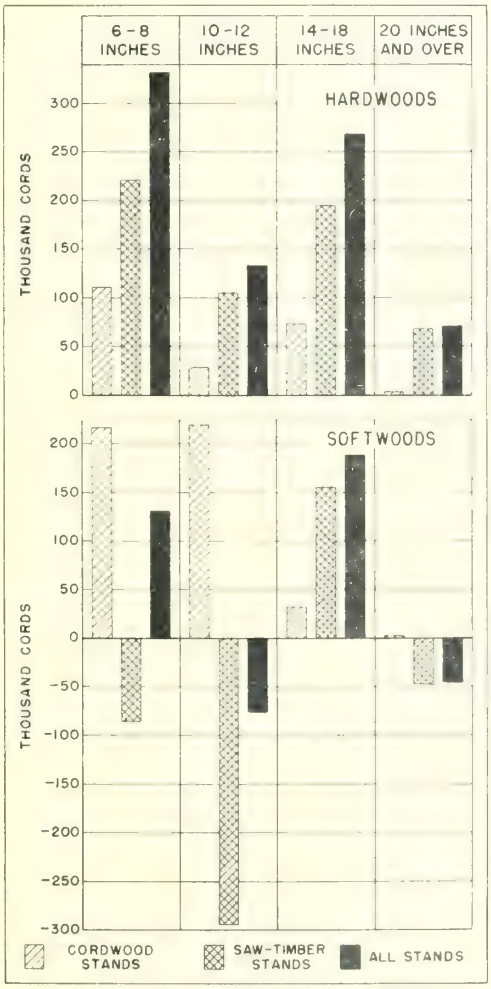


FIGURE 19- CHANGE IN CORDWOOD GROWING STOCK BY TREE-DIAMETER CLASS AND FOREST CONDITION, 1940.

Although the over-all net volume of softwood growing stock increased during 1940, there were rather serious decreases in certain components of the stand. This is illustrated in figure 19, which shows the net change in growing stock by diameter classes for cordwood and saw-timber stands and the total stand. For instance, the total volume of 6- and 8 inch trees increased but trees of these diameters in saw-timber stands were reduced in volume. Likewise the 10- and 12-inch trees in saw timber stands were reduced in volume by nearly 300,000 cords and the volume increase of similiar trees in cordwood stands was insufficient to compensate for the loss. A comparable situation exists in the 20-inch and larger diameter class.

The striking deficit in the 10- and 12-inch diameter class is caused by two factors. Over one-half of the softwood drain for nail kegs, potato barrels, excelsior, pulpwood, and fuel wood was cut from 10- and 12 inch trees and consequently 36 percent of the total softwood drain came from this single diameter class. In addition, an unusually large volume of

10- and 12-inch trees moved into the 14- to 18-inch diameter class as a result of growth during the year, accounting for 90 percent of the total increment in this larger class.

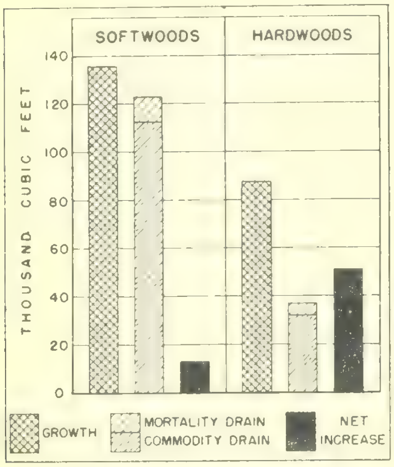


FIGURE 20-COMPARISON OF INCREMENT WITH MORTALITY AND COMMODITY DRAIN, 1940.

Comparison in cubic feet: The effect of increment and mortality and commodity drain upon the softwood and hardwood growing stock is summarized in cubic feet in figure 20. In spite of volume losses in certain diameter classes, the softwood growing stock increased by 13 million cubic feet. The hardwood growing stock increased in all species groups and diameter classes for a total gain of 51 million cubic feet.

FUTURE TIMBER SUPPLIES

The foregoing analysis of increment and drain has shown that there was a net increase in board-foot volume of both the softwood and hardwood saw timber growing stock in 1940 and also a net increase in the total volume of all sound trees 5.0 inches d.b.h. and larger. Within certain species groups and diameter classes there were decreases in growing stock volumes but the over-all picture appears favorable. This infers that the forest products industries and other wood consumers of the Coastal Plain can continue to use as much wood as in 1940 without reducing the growing stock.

Prediction of future timber supplies is hazardous for such a large area because the following factors are subject to considerable change over a period of years: commodity drain, growth rates of individual trees and stands, mortality, cutting practices, and stand composition. Nevertheless the forest industries, public conservation agencies, and the general public are so vitally interested in the future supply of timber that a prediction, based upon reasonable assumptions, is in order.

Hardwoods

The situation in respect to the supply of hardwood timber is obvious. All three species groups; oaks, gums and yellowpoplar, and other hardwoods, are increasing in all diameter classes at a very rapid rate in both the sawtimber and cordwood sizes. The chief danger is that they may increase too much at the expense of the pines. The hardwood cut can be nearly doubled without reducing the present growing stock if the cut is distributed to all species admitting, however, that special woods such as ship-timber oak, aircraft yellowpoplar and sweetgum, and select ash may be hard to find at present and even harder to find in the future.

Softwoods

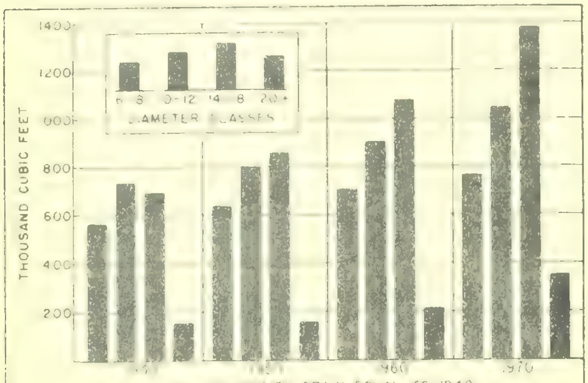
The most critical softwood species group is the "other softwoods" - cypress and cedar. Total drain is three times the net increment in these species and the growing stock is being reduced in all diameter classes. At present rates of cutting practically all of the white-cedar saw timber will be cut before 1950 and there is not enough young second growth to assure a continuous supply of saw timber in the future. The cypress will last longer but commercially it is a disappearing species in Virginia.

Virginia pine is used chiefly for pulpwood, lumber and fuel wood. It is typically a rather small, very limby tree, with the branches often extending completely to the ground. Because it is so small and knotty it is an inferior species for lumber and is less desirable than loblolly and shortleaf pine for pulpwood. Mechanical difficulties in cutting and splitting limit its use for fuel wood if other species of pine are available. In view of these factors and the favorable balance of increment over drain, it appears that Virginia pine will continue to increase, unless drain materially exceeds the 1940 level.

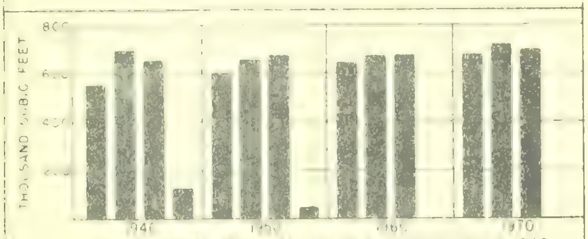
Most significant, as the forest industries are now organized, is the future supply of yellow pine - loblolly and shortleaf pine. In 1940 two-thirds of the entire quantity of wood consumed was cut from this species group, which is 90 percent loblolly pine. As a result the growing stock was reduced in the 10- and 12-inch and 20-inches and larger diameter classes, but increased in other sizes to create a net increase of 22 million board feet of saw timber and 206,000 cords of all material in trees 5 inches d.b.h. and larger. Considering this small increase in growing stock, what are the prospects for realizing the following objectives: (1) maintaining the 1940 commodity drain, (2) increasing the drain by 25 percent, or (3) increasing the drain by 35 percent between 1940 and 1950 to allow for war and post war requirements, and then dropping back to the 1940 level for the remaining 20 years?

The three sections, A, B, and C, of figure 21 indicate the possible development of the stand over a 30-year period with the commodity drain at the proposed three levels. In projecting the stand forward the following assumptions were made: (1) the volume recruiting into the 6- and 8-inch class will be maintained at the 1940 level because one-third of the yellow pine type area is now stocked with young growth and future cutting practices should at least provide for continued restocking, (2) the ratio of inventory to the volume recruiting out of any diameter class is constant at the 1940 level, and (3) the growth of the trees in any given diameter class is at the 1940 level.

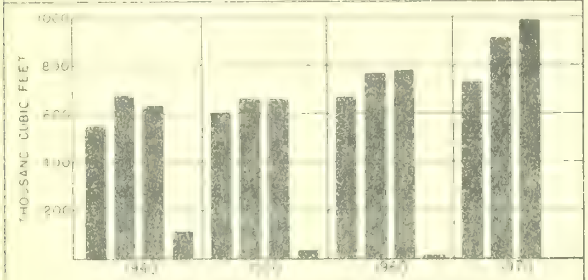
Figure 21-A is based upon the assumption that commodity drain will equal 1940 each year for 30 years and that it will be distributed among diameter classes in the same way. At this rate of cutting the growing stock increases from 2 billion cubic feet in 1940 to 3.5 billion feet in 1970, a net gain of 73 percent. The 20-inch and larger class will decrease until about 1945 but then the influx of volume from the 14-, 16-, and 18-inch trees will begin to have an effect and the 20-inch class will gradually increase. The volume distribution by diameter class of the 1970 stand is a decided improvement over the 1940 stand and indicates that cutting at the 1940 level will result in a gradual but appreciable building up of the yellow pine growing stock. In fact the stand appears to improve so rapidly that the practicality of increasing the cut is worth investigating.



A- COMMODITY DRAIN EQUAL TO 1940



B- COMMODITY DRAIN 25 PERCENT GREATER THAN 1940



C- COMMODITY DRAIN 1940-1950, 35 PERCENT GREATER THAN 1940
COMMODITY DRAIN 1950-1970, EQUAL TO 1940

FIGURE 21- POSSIBLE TRENDS IN THE VOLUME AND DISTRIBUTION OF YELLOW PINE GROWING STOCK AT THREE LEVELS OF COMMODITY DRAIN.

In figure 21-B the commodity drain has been set at 25 percent above 1940. Cutting practices are considered to remain the same so that the proportionate distribution of the drain by diameter classes remains unchanged. Obviously the growing stock is at present unable to support a 25 percent increase in cut and still build up at a satisfactory rate. Actually the total volume of growing stock remains practically constant, but trees 20 inches and larger disappear from the stand. An emergency demand for lumber and pulp or an acute need for forest employment might be justification for cutting at this rate for a short period, but in the long run the people and forest industries of the Coastal Plain will derive greater benefit from the forest resource by making only a small increase in the use of yellow pine.

With the outbreak of war in 1941 the demands upon the forests of coastal Virginia have greatly increased. The yellow pines are the leading species used for construction of army camps, air field facilities, defense houses and army depots. Great quantities of yellow pine piles and timbers are used at shipyards, and vast numbers of pine crossties are required to maintain the railroads of a nation at war. To win the war it is essential that we produce all the lumber and timber products that are needed and, if conservative cutting methods are practiced, the yellow pine forests of coastal Virginia can contribute their full share and still be productive in the post-war period.

In figure 21-C the commodity drain has been set at 35 percent above the 1940 level for the 1940 to 1950 period and has then been decreased to the 1940 level for the remaining 20 years. The excessive demands of war and post-war construction are thus amply allowed for, as it is doubtful whether the drain upon the yellow pine will be 35 percent higher than 1940 even at the height of the war effort. Under these conditions the growing stock can be expected to increase from 2 billion cubic feet in 1940 to 2.6 billion feet in 1970 although the heavy cutting in the 1940-1950 year period will practically eliminate the trees 20-inches and larger from the stand.

From a practical standpoint there appear to be only two choices if the forest is to continue to be productive. The attainment of stands A or C, illustrated in figure 21, depends upon the cooperation of the wood-using industries and other landowners in promoting and practicing timber harvesting methods that will maintain a productive growing stock of pine upon the forest land. For instance, cutting all of the pine from mixed pine-hardwood stands reduces the pine acreage. Failure to leave enough seed trees for adequate restocking prevents the constant replenishment of the 6- and 8 inch diameter classes so necessary for a continuous supply of pine. Also, cutting the young small-sized timber lowers the productivity of the stand because more trees must be cut to obtain a given volume and these are the trees which are growing most rapidly. Fire protection is essential and in this the landowners should cooperate actively with the Virginia Forest Service. If these, and other constructive measures are followed, it is reasonable to expect the over-all supply of yellow pine to increase although the probability remains that there will be local shortages due to concentrated over cutting, unavailable ownerships, or a predominance of young unmerchantable timber.

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Table 22.- Species composition of the forest types expressed in percent of net cubic volume (inside bark), 1940

Species	Loblolly pine	Virginia pine	Shortleaf pine	Cypress-cedar	Upland hardwoods	Bottomland hardwoods	All types
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Loblolly pine	73.0	19.9	17.4	2.9	7.2	6.2	43.0
Shortleaf pine	3.2	2.8	52.7	-	1.2	0.1	4.0
Virginia pine	1.6	41.9	1.2	-	1.5	0.1	3.6
Pond pine	0.1	-	-	-	-	negl.	negl.
Cypress	0.1	-	-	37.9	negl.	3.2	1.2
White-cedar	negl.	-	-	15.9	negl.	0.2	0.3
Redcedar	0.1	0.1	0.8	0.2	0.1	negl.	0.1
Red oaks - poor	3.6	9.9	7.4	0.5	15.4	4.0	6.4
Red oaks - good	0.6	0.4	0.6	-	3.2	1.9	1.3
White oaks - poor	0.6	1.2	2.5	0.2	2.4	0.4	1.0
White oaks - good	3.5	7.5	5.6	0.1	18.0	3.5	6.5
Sweetgum	6.0	4.1	5.3	5.2	12.2	20.1	9.4
Tupelos	1.8	1.3	0.8	26.6	3.0	27.4	6.8
Yellowpoplar	2.5	5.1	2.4	1.5	13.1	6.2	5.3
Red maple	0.9	0.4	0.5	3.5	2.5	9.6	2.7
Beech	0.5	1.4	0.2	0.2	8.2	0.8	2.0
Hickory	0.6	2.3	1.1	0.1	7.2	1.0	2.1
Ash	negl.	negl.	0.1	1.7	0.5	5.6	1.1
Dogwood	0.4	0.9	0.4	0.1	1.5	0.8	0.7
Scrub hardwoods	0.3	0.4	0.4	0.5	0.8	1.2	0.5
Other hardwoods	0.5	0.4	0.6	2.9	2.0	7.7	2.0
All species	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 23. - Forest area classified by forest condition and forest type, 1940

orest condition	Lob-lolly pine[1]	Vir-ginia pine	Short-leaf pine	Cypress-cedar	Upland hard-woods	Bottom-land hard-woods	All types	
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Percent
w-timber stands:								
Old growth:								
Uncut	10.500	-	800	4,000	18,500	29,000	62,800	1.6
Partly cut	12,900	-	-	2,400	20,100	13,700	49,100	1.3
Total	23,400	-	800	6,400	38,600	42,700	111,900	2.9
Second growth:								
Uncut	906,100	122,300	69,100	16,200	307,500	282,500	1,703.700	43.4
Partly cut	350,100	49,900	24.200	4,800	175,400	57,100	661.500	16.9
Total	1,256,200	172,200	93,300	21,000	482,900	339,600	2,365,200	60.3
l saw timber	1,279,600	172,200	94,100	27,400	521,500	382,300	2,477,100	63.2
rdwood stands:								
Second growth	548.800	135,200	65,200	5,600	367,000	154,500	1,276,300	32.6
Reproduction	91,000	23,400	4,800	3,200	8,800	34,600	165,800	4.2
l cordwood	639,800	158,600	70,000	8,800	375,800	189,100	1,442,100	36.8
l conditions	1,919,400	330,800	164,100	36,200	897,300	571,400	3,919.200	100.0
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
	49.0	8.4	4.2	0.9	22.9	14.6	100.0	-

[1] Includes 12,100 acres of pond pine type.

Table 24. - Distribution of forest-type area by age class, 1940

Age class	Loblolly pine	Virginia pine	Shortleaf pine	Cypress-cedar	Upland hardwoods	Bottomland hardwoods	All types
Years	Acres	Acres	Acres	Acres	Acres	Acres	Acres
10	263,000	66,500	9,400	16,000	56,600	117,700	529,200
20	351,300	63,800	17,100	-	53,000	31,400	516,600
30	412,700	63,900	44,100	1,400	101,400	43,400	666,900
40	370,400	52,900	32,300	-	160,600	56,600	672,800
50	239,900	40,000	27,300	2,900	154,300	49,700	514,100
60	147,800	20,200	18,700	1,400	148,100	52,600	388,800
70	63,300	13,600	7,700	2,900	97,800	62,900	248,200
80	30,700	6,300	5,900	-	52,900	41,700	137,500
90	19,200	1,000	800	-	22,400	23,400	66,800
100 +	21,100	2,600	800	11,600	50,200	92,000	178,300
Total	1.919,400	330,800	164,100	36,200	897,300	571.400	3,919,200

Table 25. - Net board-foot volume by species and three log rules, 1940

Species	International ¼-inch	Scribner	Doyle
	M bd. ft.	M bd. ft.	M bd. ft.
Softwoods:			
Loblolly pine	6,835,900	5,834,800	3,941,900
Shortleaf pine	450,000	371,900	229,000
Virginia pine	352,500	292,600	181,200
Pond pine	3,500	2,900	1,700
Cypress-cedars	277,300	242,800	178,400
All softwoods	7,919,200	6,745,000	4,532,200
Hardwoods:			
Red oaks - poor	446,300	406,300	328,400
Red oaks - good	152,200	140,500	121,600
White oaks - poor	51,100	46,400	37,300
White oaks - good	363,000	329,600	263,900
Sweetgum	777,900	702,500	544,000
Tupelos	648,200	590,600	479,000
Yellowpoplar	529,700	480,800	383,000
Red maple	221,900	201,000	158,200
Beech	223,600	204,100	166,600
Hickory	145,200	131,400	103,000
Ash	91,800	83,100	65,000
Other hardwoods	177,900	161,600	128,800
All hardwoods	3,828,800	3,477,900	2,778,800
All species	11,748,000	10,222,900	7,311,000

Table 26. - Net board-foot volume, International $\frac{1}{4}$-inch rule, by species and forest conditions, 1940

Species	Saw-timber stands			Cordwood stands[1]	All conditions	
	Old growth	Second growth				
		Uncut	Partly cut			
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:						
Loblolly pine[2]	371,500	5,063,800	1,262,900	141,200	6,839,400	58.2
Shortleaf pine	28,700	321,600	83,100	16,600	450,000	3.8
Virginia pine	2,000	267,700	66,500	16,300	352,500	3.0
Cypress	60,000	118,700	22,400	800	201,900	1.7
White-cedar	43,400	20,300	300	900	64,900	0.6
Redcedar	-	8,200	700	1,600	10,500	0.1
All softwoods	505,600	5,800,300	1,435,900	177,400	7,919,200	67.4
Hardwoods:						
Red oaks - poor	36,300	279,400	117,600	13,000	446,300	3.8
Red oaks - good	32,700	84,100	32,600	2,800	152,200	1.3
White oaks - poor	8,100	31,900	10,200	900	51,100	0.4
White oaks - good	28,700	238,500	80,100	15,700	363,000	3.1
Sweetgum	80,100	514,900	161,100	21,800	777,900	6.6
Tupelos	273,800	308,200	57,800	8,400	648,200	5.5
Yellowpoplar	71,200	354,800	93,600	10,100	529,700	4.5
Red maple	27,500	141,400	44,800	8,200	221,900	1.9
Beech	60,400	111,400	46,400	5,400	223,600	1.9
Hickory	22,500	71,400	44,900	6,400	145,200	1.3
Ash	19,000	69,800	3,000	-	91,800	0.8
Other hardwoods	34,600	113,600	26,800	2,900	177,900	1.5
All hardwoods	694,900	2,319,400	718,900	95,600	3,828,800	32.6
All species	1,200,500	8,119,700	2,154,800	273,000	11,748,000	100.0
	Percent	Percent	Percent	Percent	Percent	
	10.2	69.1	18.4	2.3	100.0	-

[1] Includes reproduction condition.

[2] Includes 3.5 million board feet of pond pine.

Table 27. - Net board-foot volume, International $\frac{1}{4}$-inch rule, by species and tree-diameter class (inches), 1940

Species	10 and 12	14, 16, and 18	20, 22, and 24	26 and over	All diameters
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.
Softwoods:					
Loblolly pine	2,749,900	3,126,900	764,400	198,200	6,839,400
Shortleaf pine	277,700	150,400	14,900	7,000	450,000
Virginia pine	203,600	137,800	11,100	-	352,500
Cypress	55,900	88,300	42,800	14,900	201,900
White-cedar	7,100	29,500	26,200	2,100	64,900
Redcedar	6,400	3,300	800	-	10,500
All softwoods	3,300,600	3,536,200	860,200	222,200	7,919,200
Hardwoods:					
Red oaks - poor	-	244,300	122,200	79,800	446,300
Red oaks - good	-	48,600	53,400	50,200	152,200
White oaks - poor	-	29,900	10,700	10,500	51,100
White oaks - good	-	222,100	74,200	66,700	363,000
Sweetgum	-	544,600	186,100	47,200	777,900
Tupelos	-	366,000	174,500	107,700	648,200
Yellowpoplar	-	317,600	141,500	70,600	529,700
Red maple	-	145,300	63,600	13,000	221,900
Beech	-	116,700	78,500	28,400	223,600
Hickory	-	92,300	43,300	9,600	145,200
Ash	-	63,100	18,600	10,100	91,800
Other hardwoods	-	109,800	45,800	22,300	177,900
All hardwoods	-	2,300,300	1,012,400	516,100	3,828,800
All species	3,300,600	5,836,500	1,872,600	738,300	11,748,000

Table 28. - Average board-foot volume per acre, International ¼-inch rule, by forest type and forest condition, 1940

Forest type	Saw-timber stands				Cord-wood stands	Weighted average of all conditions
	Old growth	Second growth		Weighted average		
		Uncut	Partly cut			
	Bd. ft.	Bd. ft.	Bd. ft.	Bd. ft.	Bd. ft.	Bd. ft.
Loblolly pine	14,910	5,910	3,920	5,530	180	3,740
Virginia pine	--	3,150	2,300	2,900	130	1,570
Shortleaf pine	19,250	3,410	2,800	3,380	230	2,040
Cypress-whitecedar	16,360	6,020	5,460	8,340	-	6,310
Upland hardwoods	6,780	2,920	2,120	2,940	240	1,810
Bottomland hdwds	11,000	4,080	3,500	4,760	180	3,250
Average all types	10,730	4,770	3,260	4,630	190	3,000

Table 29. - Net cordwood volume of all sound material, including bark, by species and quality class, 1940

Species	Saw-timber trees		Cordwood trees	Cull trees	Total	
	Sawlogs	Upper stems				
	Cords	Cords	Cords	Cords	Cords	Percent
Softwoods:						
Loblolly pine	16,758,400	3,524,400	7,001,100	638,700	27,922,600	37.6
Shortleaf pine	1,171,800	282,600	1,107,700	46,800	2,608,900	3.5
Virginia pine	910,900	321,600	1,107,200	219,000	2,558,700	3.4
Cypress-cedars	656,700	160,400	153,000	87,400	1,057,500	1.4
All softwoods	19,497,800	4,289,000	9,369,000	991,900	34,147,700	45.9
Hardwoods:						
Red oaks	1,615,900	919,500	2,834,300	612,900	5,982,600	8.1
White oaks	1,160,800	637,000	3,541,600	743,300	6,082,700	8.2
Sweetgum	1,879,800	1,122,700	3,527,700	993,900	7,524,100	10.1
Tupelos	1,834,700	1,025,500	1,803,600	1,708,200	6,372,000	8.6
Yellowpoplar	1,330,100	749,500	1,636,600	290,200	4,006,400	5.4
Red maple	601,600	349,600	835,500	1,254,100	3,040,800	4.1
Beech	587,500	358,200	401,800	395,800	1,743,300	2.4
Hickory	429,200	239,200	772,600	132,100	1,573,100	2.1
Ash	232,800	129,800	424,700	289,500	1,076,800	1.4
Other hardwoods	453,400	270,400	1,108,800	945,100	2,777,700	3.7
All hardwoods	10,125,800	5,801,400	16,887,200	7,365,100	40,179,500	54.1
All species	29,623,600	10,090,400	26,256,200	8,357,000	74,327,200	100.0

Table 30. - Net cordwood volume of sound trees by species and diameter class, 1940

Species	Tree-diameter class (inches)				Total	
	6 - 8	10 - 12	14, 16, and over	20 and over		
	Cords	Cords	Cords	Cords	Cords	Per-cent
Softwoods:						
Loblolly pine	7,001,100	9,796,300	8,303,200	2,183,300	27,283,900	45.4
Shortleaf pine	1,107,700	1,006,300	399,500	48,600	2,562,100	4.3
Virginia pine	1,107,200	802,500	401,300	28,700	2,339,700	3.9
Cypress-cedars	153,000	193,000	291,700	185,700	823,400	1.4
All softwoods	9,369,000	11,798,100	9,395,700	2,446,300	33,009,100	55.0
Hardwoods:						
Red oaks	1,306,300	1,528,000	871,600	744,300	4,450,200	7.4
White oaks	1,582,900	1,958,700	759,300	401,500	4,702,400	7.8
Sweetgum	1,578,600	1,949,100	1,359,000	520,800	5,407,500	9.0
Tupelos	652,900	1,150,700	1,101,200	733,500	3,638,300	6.1
Yellowpoplar	710,200	926,400	841,900	488,200	2,966,700	4.9
Red maple	386,500	449,000	410,300	191,300	1,437,100	2.4
Beech	136,100	265,700	328,900	258,600	989,300	1.7
Hickory	339,300	433,300	288,200	141,000	1,201,800	2.0
Ash	215,500	209,200	166,100	66,700	657,500	1.1
Other hardwoods	567,500	501,900	336,000	156,800	1,562,200	2.6
All hardwoods	7,475,800	9,372,000	6,462,500	3,702,700	27,013,000	45.0
All species	16,844,800	21,170,100	15,858,200	6,149,000	60,022,100	100.0

Table 31. - Average cordwood volume per acre by forest type and forest condition, 1940

Forest type	Saw-timber stands				Cord-wood stands	Weighted average of all conditions
	Old growth	Second growth		Weighted average		
		Uncut	Partly cut			
	Cords	Cords	Cords	Cords	Cords	Cords
Loblolly pine	37.71	25.43	18.10	23.65	4.72	17.34
Virginia pine	-	17.92	14.44	16.91	4.37	10.90
Shortleaf pine	46.75	19.25	16.40	18.75	6.30	13.44
Cypress-whitecedar	53.28	26.64	22.94	32.21	.07	24.40
Upland hardwoods	21.27	16.75	13.73	16.07	7.02	12.28
Bottomland hardwoods	35.81	20.72	15.95	21.69	3.89	15.80
Average all types	32.27	22.30	16.45	21.19	5.22	15.31

Table 32. - Net cubic-foot volume of all sound wood, without bark, by species and quality class, 1940

Species	Saw-timber trees		Cordwood trees	Cull trees	All classes	
	Sawlogs	Upper stems				
	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	Percent
Softwoods:						
Loblolly pine	1,174,500	245,820	454,730	43,760	1,918,820	39.3
Shortleaf pine	81,080	19,400	71,890	3,140	175,510	3.6
Virginia pine	62,340	22,140	71,810	14,860	171,150	3.5
Cypress-cedars	50,980	9,900	11,060	6,910	78,850	1.6
All softwoods	1,368,910	297,260	609,490	68,670	2,344,330	48.0
Hardwoods:						
Red oaks	107,880	54,480	170,430	39,390	372,180	7.6
White oaks	76,830	37,750	212,460	47,760	374,800	7.7
Sweetgum	127,760	66,660	217,300	63,110	474,830	9.7
Tupelos	121,530	59,450	113,400	111,380	405,760	8.3
Yellowpoplar	86,560	42,770	100,250	18,860	248,440	5.1
Red maple	41,000	21,290	55,090	84,260	201,640	4.2
Beech	40,520	21,980	25,950	26,250	114,700	2.3
Hickory	28,230	14,080	47,740	8,310	98,360	2.0
Ash	15,140	7,410	25,960	18,350	66,860	1.4
Other hardwoods	31,150	16,470	70,800	60,920	179,340	3.7
All hardwoods	676,600	342,340	1,039,380	478,590	2,536,910	52.0
All species	2,045,510	639,600	1,648,870	547,260	4,881,240	100.0

Table 33. - Number of pine poles, by diameter and length, 1940

D.b.h. of trees (outside bark)	Pole length (feet)						All lengths	
	20	25	30	35	40	45 & over		
Inches	1,000 poles	1,000 poles	1,000 poles	1,000 poles	1,000 poles	1,000 poles	1,000 poles	Percent
7.0 - 8.9	4,700	1,460	410	100	-	-	6,670	31.2
9.0 - 10.9	2,640	1,970	1,300	730	230	20	6,890	32.3
11.0 - 12.9	1,360	1,210	980	710	430	170	4,860	22.8
13.0 - 14.9	240	370	440	420	340	230	2,040	9.5
15.0 - 16.9	-	100	130	160	170	180	740	3.5
17.0 - 18.9	-	-	20	30	40	70	160	0.7
All sizes	8,940	5,110	3,280	2,150	1,210	670	21,360	100.0
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
	41.8	23.9	15.4	10.1	5.7	3.1	100.0	-

Table 34. - Descriptive summary of sawmills by capacity class, 1940

Item	Rated capacity M bd. ft. in 8-hours 1-9	10-19	20-39	40 +	All mills
	Number	Number	Number	Number	Number
Sawmills:	506	49	9	3	567
Portable	386	21	-	-	407
Stationary	120	28	9	3	160
Power:					
Steam	242	38	8	3	291
Gasoline	205	3	-	-	208
Diesel	55	8	-	-	63
Electric	4	-	1	-	5
Feed:					
Belt or friction	502	30	1	-	533
Auxiliary steam	4	16	1	-	21
Shotgun	-	3	7	3	13
Equipment:					
Circular saw	506	43	1	-	550
Band saw	-	6	8	3	17
Resaw	5	5	2	2	14
Edger	179	47	9	3	238
Trimmer	38	16	8	3	65
Planer	63	14	4	2	83
Dry kiln	3	7	6	3	19

Table 35. - Methods of logging at sawmills of various capacity classes, 1940

Item	Rated capacity M bd. ft. in 8-hours 1-9	10-19	20-39	40 +
	Percent	Percent	Percent	Percent
Bunching:				
Animals	98	92	91	67
Tractors	2	2	29	67
Skidders	negl.	10	--	67
Short haul:				
High wheels				
Animals	88	100	50	--
Tractors	5	-	50	-
Other	7	-	-	-
Long haul:				
Trucks	96	100	100	100
Railroad	-	11	-	67
Other	4	-	-	33
	Miles	Miles	Miles	Miles
Avg. length short haul	1/3	2/5	1/2	-
Avg. length long haul	6	10	14	48

Table 36. - Lumber production by species group and capacity class of sawmill, 1940

Species group	Rated capacity M bd. ft. in 8-hours				All mills	
	1-9	10-19	20-39	40 +		
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:						
Yellow pine1/	221,600	72,800	41,700	47,200	383,300	77.9
Virginia pine	19,000	1,000	100	-	20,100	4.1
Other	600	2,800	700	10,800	14,900	3.0
All softwoods	241,200	76,600	42,500	58,000	418,300	85.0
Hardwoods:						
Oaks	20,100	4,500	1,300	200	26,100	5.3
Gums2/	13,400	5,800	3,000	22,600	44,800	9.1
Other	300	100	100	2,500	3,000	0.6
All hardwoods	33,800	10,400	4,400	25,300	73,900	15.0
All species	275,000	87,000	46,900	83,300	492,200	100.0

1/Loblolly and shortleaf pine.
2/Black and water tupelo, sweetgum, and yellowpoplar.

Table 37. - Lumber production by species group and diameter class, 1940

Species group	Diameter - class (inches)				All diameters	
	6-8	10-12	14-18	20 +		
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:						
Yellow pine1/	2,300	47,900	171,300	161,800	383,300	77.9
Virginia pine	500	10,400	9,200	-	20,100	4.1
Other	300	2,000	5,200	7,400	14,900	3.0
All softwoods	3,100	60,300	185,700	169,200	418,300	85.0
Hardwoods:						
Oaks	-	800	10,500	14,800	26,100	5.3
Gums2/	-	1,000	13,800	30,000	44,800	9.1
Other	-	100	1,000	1,900	3,000	0.6
All hardwoods	-	1,900	25,300	46,700	73,900	15.0
All species	3,100	62,200	211,000	215,900	492,200	100.0

1/Loblolly and shortleaf pine.
2/Black and water tupelo, sweetgum, and yellowpoplar.

Table 38. - Average net increment per acre by forest type and species group, 1940

SAW-TIMBER STANDS

Forest type	Yellow pines	Virginia pine	Other softwoods	Oaks	Gums-yellow-poplar	Other hardwoods	All species	
	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Bd.ft.	Cu.ft.
Loblolly pine	284	4	negl.	12	17	4	321	70.6
Shortleaf pine	166	2	negl.	16	11	2	197	54.9
Virginia pine	54	94	negl.	26	12	4	190	49.2
Cypress-cedars	20	-	132	2	98	20	272	100.5
Upland hardwood	25	6	negl.	58	49	28	166	45.7
Bottomland hardwood	33	1	6	29	139	43	251	63.1
All types	167	10	3	25	43	15	263	62.5

CORDWOOD STANDS (under-sawlog-size conditions)

	Cords	Cords	Cords	Cords	Cords	Cords	Cords	Cu.ft.
Loblolly pine	.52	.02	-	.04	.05	.01	.64	36.0
Shortleaf pine	.62	.03	-	.09	.05	.01	.80	48.0
Virginia pine	.13	.48	-	.05	.05	.02	.73	33.2
Cypress-cedars	-	-	-	-	-	-	-	-
Upland hardwood	.10	.02	-	.27	.16	.09	.64	51.7
Bottomland hardwood	.04	negl.	-	.04	.18	.12	.38	29.3
All types	.30	.07	-	.10	.10	.05	.62	39.3

Table 39. - Net increment in board feet, Int. ¼-inch rule, by species group and tree-diameter class, 1940

Species group	Diameter class (inches)			All diameters	
	10-12	14-18	20 +		
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:					
Yellow pine[1]	126,800	234,900	111,200	472,900	63.2
Virginia pine	20,400	13,200	200	33,800	4.5
Other	200	3,900	2,100	6,200	0.8
All softwoods	147,400	252,000	113,500	512,900	68.5
Hardwoods:					
Oaks	-	56,200	21,800	78,000	10.4
Gums[2]	-	77,200	40,300	117,500	15.7
Other	-	22,000	18,200	40,200	5.4
All hardwoods	-	155,400	80,300	235,700	31.5
All species	147,400	407,400	193,800	748,600	100.0

[1] Loblolly and shortleaf pine.
[2] Black and water tupelo, sweetgum, and yellowpoplar.

Table 40. - Net increment in cords by species group and tree-diameter class, 1940

Species group	Diameter class (inches)				All diameters	
	6-8	10-12	14-18	20 +		
	Cords	Cords	Cords	Cords	Cords	Percent
Softwoods:						
Yellow pine[1]	246,400	419,900	671,400	259,900	1,597,600	51.4
Virginia pine	79,500	73,200	40,800	400	193,900	6.2
Other	-3,500	1,500	9,000	4,400	11,400	0.4
All softwoods	322,400	494,600	721,200	264,700	1,802,900	58.0
Hardwoods:						
Oaks	138,800	160,300	167,400	54,000	520,500	16.7
Gums[2]	174,500	90,500	191,200	96,400	552,600	17.8
Other	88,900	38,400	60,100	44,700	232,100	7.5
All hardwoods	402,200	289,200	418,700	195,100	1,305,200	42.0
All species	724,600	783,800	1,139,900	459,800	3,108,100	100.0

[1] Loblolly and shortleaf pine.
[2] Black and water tupelo, sweetgum, and yellowpoplar.

Table 41. - Net increment in cubic feet by species group and tree-diameter class, 1940

Species group	Diameter class (inches)				All diameters	
	6-8	10-12	14-18	20+		
	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	Percent
Softwoods:						
Yellow pine[1]	15,890	28,610	47,920	19,330	111,750	53.6
Virginia pine	5,150	4,940	2,870	30	12,990	6.2
Other	-250	100	710	360	920	0.4
All softwoods	20,790	33,650	51,500	19,720	125,660	60.2
Hardwoods:						
Oaks	8,140	9,810	10,800	3,750	32,500	15.6
Gums[2]	10,400	5,750	12,640	6,520	35,310	16.9
Other	5,570	2,470	4,000	3,110	15,150	7.3
All hardwoods	24,110	18,030	27,440	13,380	82,960	39.8
All species	44,900	51,680	78,940	33,100	208,620	100.0

[1] Loblolly and shortleaf pine.

[2] Black and water tupelo, sweetgum, and yellowpoplar.

Table 42. - Drain by commodity and species group, 1940

IN BOARD FEET (INT. $\frac{1}{4}$-INCH RULE)

Commodity	Yellow pine	Virginia pine	Other softwoods	Oaks	Gums & yellow-poplar	Other hardwoods	All species	
	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	Percent
Lumber	311,900	18,200	10,300	24,200	34,200	2,000	400,800	66.2
Veneer	700	-	100	-	15,400	300	16,500	2.7
Nail kegs	19,900	-	-	-	300	-	20,200	3.3
Potato barrels	1,100	-	-	-	-	-	1,100	0.2
Excelsior	6,600	300	-	-	-	-	6,900	1.1
Pulpwood	62,200	13,200	-	-	900	-	76,300	12.6
Misc.mfg.products1/	1,200	-	900	300	100	300	2,800	0.5
Fuel wood	34,900	6,100	-	9,300	2,200	900	53,400	8.8
Hewn crossties	200	-	-	12,100	-	-	12,300	2.0
Poles and piles	12,500	-	-	300	500	200	13,500	2.2
Fence posts	100	-	900	900	100	100	2,100	0.4
All products	451,300	37,800	12,200	47,100	53,700	3,800	605,900	100.0

IN CORDS

Commodity	Yellow pine	Virginia pine	Other softwoods	Oaks	Gums & yellow-poplar	Other hardwoods	All species	
	Cords	Cords	Cords	Cords	Cords	Cords	Cords	Cords
Lumber	803,500	63,800	24,800	69,600	89,100	5,400	1,056,200	50.2
Veneer	1,800	-	200	-	39,400	700	42,100	2.0
Nail kegs	75,000	-	-	-	1,500	-	76,500	3.6
Potato barrels	4,500	-	-	-	-	-	4,500	0.2
Excelsior	36,700	2,200	-	-	-	-	38,900	1.8
Pulpwood	269,300	72,500	-	-	7,300	-	349,100	16.6
Misc.mfg.products1/	3,400	-	5,200	700	500	1,100	10,900	0.5
Fuel wood	160,700	38,100	-	160,500	38,900	22,500	420,700	20.0
Hewn crossties	900	-	100	48,200	100	-	49,300	2.4
Poles and piles	35,300	300	-	800	1,400	600	38,400	1.8
Fence posts	600	200	5,700	6,400	200	5,600	18,700	0.9
All products	1,391,700	177,100	36,000	286,200	178,400	35,900	2,105,300	100.0

1/Includes miscellaneous cooperage, handles, wood turning, shingles, boxes, shuttle blocks.

Table 43. - Drain by commodity and tree-diameter class, 1940

IN BOARD FEET (INT ¼-INCH RULE)

Commodity	Diameter-class (inches) 6-8	10-12	14-18	20 +	All diameters
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.
Lumber	-	50,300	173,900	176,600	400,800
Veneer	-	-	5,900	10,600	16,500
Nail kegs	-	12,200	8,000	-	20,200
Potato barrels	-	800	300	-	1,100
Excelsior	-	5,500	1,400	-	6,900
Pulpwood	-	55,500	20,800	-	76,300
Misc. mfg. products1/	-	1,000	1,500	300	2,800
Fuelwood		31,400	18,400	3,600	53,400
Hewn crossties	-	200	12,100	-	12,300
Poles and piles	-	2,000	11,500	-	13,500
Fence posts	-	900	1,100	100	2,100
All products	-	159,800	254,900	191,200	605,900
	Percent	Percent	Percent	Percent	Percent
	-	26.4	42.1	31.5	100.0

IN CORDS

Commodity	6-8	10-12	14-18	20 +	All diameters
	Cords	Cords	Cords	Cords	Cords
Lumber	10,700	185,700	460,700	399,100	1,056,200
Veneer	-	900	15,800	25,400	42,100
Nail kegs	11,100	44,200	21,200	-	76,500
Potato barrels	800	2,800	900	-	4,500
Excelsior	15,700	19,400	3,800	-	38,900
Pulpwood	87,300	206,000	55,800	-	349,100
Misc. mfg. products1/	2,900	3,500	3,600	900	10,900
Fuelwood	124,700	235,500	52,000	8,500	420,700
Hewn crossties	200	13,000	36,100	-	49,300
Poles and piles	500	7,200	30,700	-	38,400
Fence posts	7,600	7,900	2,900	300	18,700
All products	261,500	726,100	683,500	434,200	2,105,300
	Percent	Percent	Percent	Percent	Percent
	12.4	34.5	32.5	20.6	100.0

1/Includes miscellaneous cooperage, handles, wood turning, shingles, boxes, shuttle blocks.

Table 44. - Commodity drain in board feet (Int. ¼-inch rule) by species group and tree-diameter class, 1940

Species group	Diameter class (inches)			All diameters	
	10-12	14-18	20 +		
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	Percent
Softwoods:					
Yellow pine[1]	131,200	185,700	134,400	451,300	74.5
Virginia pine	25,700	12,100	-	37,800	6.2
Other	2,900	4,000	5,300	12,200	2.0
All softwoods	159,800	201,800	139,700	501,300	82.7
Hardwoods:					
Oaks	-	30,900	16,200	47,100	7.8
Gums[2]	-	20,000	33,700	53,700	8.9
Other	-	2,200	1,600	3,800	0.6
All hardwoods	-	53,100	51,500	104,600	17.3
All species	159,800	254,900	191,200	605,900	100.0

[1] Loblolly and shortleaf pine.
[2] Black and water tupelo, sweetgum, and yellowpoplar.

Table 45. - Commodity drain in cords by species group and tree-diameter class, 1940

Species group	Diameter class (inches)				All diameters	
	6 8	10-12	14-18	20 +		
	Cords	Cords	Cords	Cords	Cords	Percent
Softwoods:						
Yellow pine[1]	143,000	461,900	487,800	299,000	1,391,700	66.1
Virginia pine	41,300	100,300	35,500	-	177,100	8.4
Other	6,900	8,300	9,700	11,100	36,000	1.7
All softwoods	191,200	570,500	533,000	310,100	1,604,800	76.2
Hardwoods:						
Oaks	44,300	111,100	91,100	39,700	286,200	13.6
Gums[2]	14,800	29,800	53,500	80,300	178,400	8.5
Other	11,200	14,700	5,900	4,100	35,900	1.7
All hardwoods	70,300	155,600	150,500	124,100	500,500	23.8
All species	261,500	726,100	683,500	434,200	2,105,300	100.0

[1] Loblolly and shortleaf pines.
[2] Black and water tupelo, sweetgum, and yellowpoplar.

Table 46. - Commodity drain in cubic feet by species group and tree-diameter class, 1940

Species group	Diameter class (inches)				All diameters	
	6-8	10-12	14-18	20+		
	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	Percent
Softwoods:						
Yellow pine[1]	9,290	31,480	34,850	22,230	97,850	67.6
Virginia pine	2,690	6,790	2,500	-	11,980	8.3
Other	500	610	770	890	2,770	1.9
All softwoods	12,480	38,880	38,120	23,120	112,600	77.8
Hardwoods:						
Oaks	2,600	6,790	5,880	2,760	18,030	12.5
Gums[2]	880	1,900	3,530	5,430	11,740	8.1
Other	700	950	390	280	2,320	1.6
All hardwoods	4,180	9,640	9,800	8,470	32,090	22.2
All species	16,660	48,520	47,920	31,590	144,690	100.0

[1] Loblolly and shortleaf pine.
[2] Black and water tupelo, sweetgum, and yellowpoplar.

Table 47. - Net change in growing stock by species group and tree-diameter class, 1940

IN BOARD FEET (INT. ¼-INCH RULE)

Species group	Diameter class (inches)				All diameters
	6-8	10-12	14-18	20+	
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.
Softwoods:					
Yellow pine[1]	-	-4,400	49,200	-23,200	21,600
Virginia pine	-	-5,300	1,100	200	-4,000
Other	-	-2,700	-100	-3,200	-6,000
All softwoods	-	-12,400	50,200	-26,200	11,600
Hardwoods:					
Oaks	-	-	25,300	5,600	30,900
Gums[2]	-	-	57,200	6,600	63,800
Other	-	-	19,800	16,600	36,400
All hardwoods	-	-	102,300	28,800	131,100
All species	-	-12,400	152,500	2,600	142,700

IN CORDS

	Cords	Cords	Cords	Cords	Cords
Softwoods:					
Yellow pine[1]	103,400	-42,000	183,600	-39,100	205,900
Virginia pine	38,200	-27,100	5,300	400	16,800
Other	-10,400	-6,800	-700	-6,700	-24,600
All softwoods	131,200	-75,900	188,200	-45,400	198,100
Hardwoods:					
Oaks	94,500	49,200	76,300	14,300	234,300
Gums[2]	159,700	60,700	137,700	16,100	374,200
Other	77,700	23,700	54.200	40,600	196,200
All hardwoods	331.900	133.600	268,200	71.000	804,700
All species	463.100	57,700	456.400	25.600	1.002.800

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[1] Loblolly and shortleaf pine.
[2] Black and water tupelo, sweetgum, and yellowpoplar.

Table 48. - Comparison between increment and drain of saw-timber material, 1940

BY SPECIES GROUP

Item	Growing stock Jan. 1, 1940	Increment	Mortality	Net increment	Commodity drain	Net change	Growing stock Jan. 1, 1941
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.
Softwoods:							
Yellow pine[1]	7,289,400	493,400	20,500	472,900	451,300	21,600	7,311,000
Virginia pine	352,500	35,000	1,200	33,800	37,800	-4,000	348,500
Other	277,300	8,600	2,400	6,200	12,200	-6,000	271,300
All softwoods	7,919,200	537,000	24,100	512,900	501,300	11,600	7,930,800
Hardwoods:							
Oaks	1,012,600	81,500	3,500	78,000	47,100	30,900	1,043,500
Gums[2]	1,955,800	123,900	6,400	117,500	53,700	63,800	2,019,600
Other	860,400	43,100	2,900	40,200	3,800	36,400	896,800
All hardwoods	3,828,800	248,500	12,800	235,700	104,600	131,100	3,959,900
All species	11,748,000	785,500	36,900	748,600	605,900	142,700	11,890,700

BY TREE-DIAMETER CLASS

Item	Growing stock Jan. 1, 1940	Increment	Mortality	Net increment	Commodity drain	Net change	Growing stock Jan. 1, 1941
Softwoods:							
10-12	3,300,600	158,900	11,500	147,400	159,800	-12,400	3,288,200
14-18	3,536,200	262,200	10,200	252,000	201,800	50,200	3,586,400
20 and over	1,082,400	115,900	2,400	113,500	139,700	-26,200	1,056,200
All softwoods	7,919,200	537,000	24,100	512,900	501,300	11,600	7,930,800
Hardwoods:							
14-18	2,300,300	160,900	5,500	155,400	53,100	102,300	2,402,600
20 and over	1,528,500	87,600	7,300	80,300	51,500	28,800	1,557,300
All hardwoods	3,828,800	248,500	12,800	235,700	104,600	131,100	3,959,900
All diameters	11,748,000	785,500	36,900	748,600	605,900	142,700	11,890,700

[1] Loblolly and shortleaf pine.
[2] Black and water tupelo, sweetgum, and yellowpoplar.

Table 49. - Comparison in cords between increment and drain of all sound material 5.0 inches d.b.h. and larger, 1940

BY SPECIES GROUP

Item	Growing stock Jan. 1, 1940	Increment	Mortality	Net increment	Commodity drain	Net change	Growing stock Jan. 1, 1941
	Cords	Cords	Cords	Cords	Cords	Cords	Cords
Softwoods:							
Yellow pine1/	29,846,000	1,726,700	129,100	1,597,600	1,391,700	205,900	30,051,900
Virginia pine	2,339,700	207,000	13,100	193,900	177,100	16,800	2,356,500
Other	823,400	20,700	9,300	11,400	36,000	-24,600	798,800
All softwoods	33,009,100	1,954,400	151,500	1,802,900	1,604,800	198,100	33,207,200
Hardwoods:							
Oaks	9,152,600	546,500	26,000	520,500	286,200	234,300	9,386,900
Gums2/	12,012,500	586,400	33,800	552,600	178,400	374,200	12,386,700
Other	5,847,900	249,700	17,600	232,100	35,900	196,200	6,044,100
All hardwoods	27,013,000	1,382,600	77,400	1,305,200	500,500	804,700	27,817,700
All species	60,022,100	3,337,000	228,900	3,108,100	2,105,300	1,002,800	61,024,900

BY TREE-DIAMETER CLASS

Item	Growing stock Jan. 1, 1940	Increment	Mortality	Net increment	Commodity drain	Net change	Growing stock Jan. 1, 1941
Softwoods:							
6-8	9,369,000	400,100	77,700	322,400	191,200	131,200	9,500,200
10-12	11,798,100	536,200	41,600	494,600	570,500	-75,900	11,722,200
14-18	9,395,700	747,900	26,700	721,200	533,000	188,200	9,583,900
20 and over	2,446,300	270,200	5,500	264,700	310,100	-45,400	2,400,900
All softwoods	33,009,100	1,954,400	151,500	1,802,900	1,604,800	198,100	33,207,200
Hardwoods:							
6-8	7,475,800	423,900	21,700	402,200	70,300	331,900	7,807,700
10-12	9,372,000	310,200	21,000	289,200	155,600	133,600	9,505,600
14-18	6,462,500	435,200	16,500	418,700	150,500	268,200	6,730,700
20 and over	3,702,700	213,300	18,200	195,100	124,100	71,000	3,773,700
All hardwoods	27,013,000	1,382,600	77,400	1,305,200	500,500	804,700	27,817,700
All diameters	60,022,100	3,337,000	228,900	3,108,100	2,105,300	1,002,800	61,024,900

1/Loblolly and shortleaf pine.
2/Black and water tupelo, sweetgum, and yellowpoplar.

Table 50. - Comparison in cubic feet between increment and drain of all sound material 5.0 inches d.b.h. and larger, 1940

BY SPECIES GROUP

Item	Growing stock Jan. 1, 1940	Increment	Mortality	Net increment	Commodity drain	Net change	Growing stock Jan. 1, 1941
	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.
Softwoods:							
Yellow pine[1]	2,047,430	120,430	8,680	111,750	97,850	13,900	2,061,330
Virginia pine	156,290	13,850	860	12,990	11,980	1,010	157,300
Other	62,980	1,610	690	920	2,770	-1,850	61,130
All softwoods	2,266,700	135,890	10,230	125,660	112,600	13,060	2,279,760
Hardwoods:							
Oaks	567,600	34,130	1,630	32,500	18,030	14,470	582,070
Gums[2]	766,800	37,480	2,170	35,310	11,740	23,570	790,370
Other	381,580	16,260	1,110	15,150	2,320	12,830	394,410
All hardwoods	1,715,980	87,870	4,910	82,960	32,090	50,870	1,766,850
All species	3,982,680	223,760	15,140	208,620	144,690	63,930	4,046,610

BY TREE-DIAMETER CLASS

Item	Growing stock Jan. 1, 1940	Increment	Mortality	Net increment	Commodity drain	Net change	Growing stock Jan. 1, 1941
Softwoods:							
6-8	609,480	25,860	5,070	20,790	12,480	8,310	617,790
10-12	803,820	36,500	2,850	33,650	38,880	-5,230	798,590
14-18	671,040	53,400	1,900	51,500	38,120	13,380	684,420
20 and over	182,360	20,130	410	19,720	23,120	-3,400	178,960
All softwoods	2,266,700	135,890	10,230	125,660	112,600	13,060	2,279,760
Hardwoods:							
6-8	448,050	25,410	1,300	24,110	4,180	19,930	467,980
10-12	588,560	19,340	1,310	18,030	9,640	8,390	596,950
14-18	425,540	28,540	1,100	27,440	9,800	17,640	443,180
20 and over	253,830	14,580	1,200	13,380	8,470	4,910	258,740
All hardwoods	1,715,980	87,870	4,910	82,960	32,090	50,870	1,766,850
All diameters	3,982,680	223,760	15,140	208,620	144,690	63,930	4,046,610

[1] Loblolly and shortleaf pine.
[2] Black and water tupelo, sweetgum, and yellowpoplar.

DEFINITION OF TERMS

General

Forest Survey Unit. -- The term "forest survey unit" denotes an area of 4 to 10 million acres in which topographic, forest, and economic conditions are reasonably homogeneous.

Land-use Classes

Commercial forest. -- Forest land having qualities essential to the production of commercial timber.

Public reserved forest. -- Forest land in federal and state ownership upon which commercial timber cutting is prohibited.

Agriculture. -- Non-forest land used for production of farm crops within the last five years.

Abandoned cropland. -- Land once cultivated, now evidently abandoned for farm crops, but not bearing forest cover.

Pasture. -- Cleared, fenced lands that are used primarily for grazing.

Marsh. -- Non-forested areas in low, boggy areas bordering lakes and streams, where drainage is too poor to permit agricultural use.

Other non-forest. -- Includes areas within the corporate limits and suburban or industrial sections of towns and cities; power, rail, and highway rights-of-way; sand dunes, water areas, and miscellaneous non-forest.

Forest Types

Loblolly pine. -- Stands in which softwood make up 25 percent or more of the dominant and codominant trees with loblolly pine predominating.

Shortleaf pine. -- Stands in which softwoods make up 25 percent or more of the dominant and codominant trees with shortleaf pine predominating.

Virginia pine. -- Stands in which softwoods make up 25 percent or more of the dominant and codominant trees with Virginia pine predominating.

Bottomland hardwoods. -- Stands of mixed hardwoods in swamps and along streams in which hardwood species make up 75 percent or more of the dominant and codominant trees.

Upland hardwoods. -- Stands on well drained, upland sites in which mixed oaks and other hardwoods constitute 75 percent or more of the dominant and codominant trees.

Diameters

D.b.h. (diameter at breast height). -- Diameter in inches, outside bark, measured at $4\frac{1}{2}$ feet from the ground.

Diameter class. -- All trees were tallied by 2-inch diameter classes each class including diameters 1.0 inch below and 0.9 inch above the stated midpoint.

Forest Condition

Saw-timber stands. -- Stands containing sufficient volume in merchantable species to make at least 600 board feet per acre in the pine types and 1,000 board feet per acre in the hardwood types.

Cordwood stands. -- Stands of second growth in which the total saw-timber volume is less than the required minimum for sawlog stands.

Reproduction. -- Stands of young second growth with little or no volume in trees over 1" in diameter, but bearing at least 80 well distributed seedlings per acre.

Clear-cut. -- Cut-over areas bearing insufficient young growth to qualify as reproduction.

Tree Classification

Sound saw-timber tree. -- A softwood tree at least 9.0 inches d.b.h., and a hardwood tree at least 13.0 inches d.b.h. with not less than one sound butt log 12 feet long, or with 50 percent of the gross volume of the tree in sound saw timber.

Sound cordwood tree. -- Any sound, straight-boled tree between 1.0 inch d.b.h. and sawlog size.

Cull tree. -- Any tree that fails to qualify as a sound tree because of poor form, excessive limbiness, rot, or other defect.

Pole tree. -- A pine tree that will produce a pole conforming to specifications of the American Standards Association.

Volume Estimates

Board-foot volume. -- The volume in board feet, exclusive of defect, of that portion of sound sawlog-size trees between the stump and the upper limit of merchantability for sawlogs, measured by the International $\frac{1}{4}$-inch rule.

Cordwood volume. -- The volume in standard cords of the sound portion of trees 5.0 inches d.b.h. and larger between stump and a minimum diameter of approximately 4.0 inches outside bark.

Cubic-foot volume. -- The solid cubic volume, excluding bark, of all material included in the cordwood estimate.

Increment

Growing stock. -- The sum of the volumes of all sound trees 5.0 inches d.b.h. and larger; dead and cull trees and tops of hardwood not included.

Board-foot increment. -- Includes the net growth on the saw-timber portion of sawlog-size trees, plus the volume in sound trees reaching sawlog size.

Cordwood increment. -- Includes the net growth on the sound stemwood of pines and cedar 5.0 inches d.b.h. and over, on under-sawlog-size hardwoods, and on the sawlog portion of sawlog-size hardwoods, plus the sound-tree volume of all species reaching 5.0 inches d.b.h. during the increment period.

Cubic-foot increment. -- Omits bark volumes, otherwise material is identical with cordwood.

Mortality

Mortality. -- The volume lost from the growing stock of the forest through the death of individual trees. Natural causes of mortality include lightning, tree competition, old age, disease, insects, drought, and wind. Fire is the major man-caused source of mortality.

Utilization

Production. -- The volume of wood manufactured or consumed within the designated area, and expressed in units of measure characteristic of the industry.

Commodity drain. -- The volume of wood cut in the designated area from sound living trees, adjusted for such cutting practices as may over-cut or under-cut the basic volume tables, and excluding the cordwood volume cut from tops of hardwoods.

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FOREST SURVEY RELEASE NO. 13 MAY 15, 1943

THE FOREST SITUATION IN PIEDMONT VIRGINIA

by

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A FOREST SURVEY PROGRESS REPORT

J. W. Cruikshank, Regional Survey Director

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE

Appalachian Forest Experiment Station
R. E. McArdle, Director
Asheville, N. C.

PREFACE

Through the McSweeny-McNary Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act, and each of the 12 Regional Experiment Stations was made responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station, Asheville, North Carolina.

The work of the Survey is divided into 5 major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of the timber on these lands.
2. Growth. Determination of the current rate of timber growth.
3. Drain. Determination of the amount of industrial and domestic wood use, and the total loss resulting from fire, insects, disease, suppression, and other causes.
4. Requirements. Determination of the current and probable future requirements for forest products by all classes of consumers.
5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis for public and private policies and plans of forest land use and management.

This Forest Survey progress report presents preliminary information on the first three of these phases for the Piedmont [1] district of Virginia, comprising two of the five units into which the State has been divided for survey purposes (units nos. 2 and 3). An attempt is made in this report also to show the historical background of the present use and condition of forest lands, to analyze the significance of the current forest situation, and to point out some desirable objectives in forest-land management. A similar report has been published for the Coastal Plain, and to complete the State one report for the two Mountain units will be released.

Information on the physical forest resources was obtained by a field survey made in the summer of 1940. In all, 12,452 quarter-acre sample plots were established at intervals of one-eighth mile on compass lines 10 miles apart, extending across the Piedmont in a northeast direction. The statistical sample obtained from these plot records forms the basis for all area and volume estimates in this report, except where other sources are directly credited. Because of the method of sampling, small tabular items have the greater probability of error and should be considered as indicating relative magnitude rather than actual values.

Data on consumption of forest products for industrial and domestic purposes were obtained by a canvass of all primary manufacturing plants and a number of representative domestic consumers, made in the first half of 1941.

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[1] The Piedmont district about which this report is written does not correspond exactly to the Piedmont physiographic province, which lies between the Blue Ridge and the fall line. The eastern boundary has been located west of the fall line so as to exclude most of the loblolly-pine forest. And all boundaries have been placed arbitrarily on county lines. (See fig. 1.)

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SUMMARY OF FINDINGS

An extensively wooded region, Piedmont Virginia has 6 million acres of forest land out of a total of 10 million acres.

Farm woodlands make up 61 percent of this forest.

Saw-timber stands comprise about half of the forest area; cordwood stands, most of the remainder.

Severe depletion typifies the forest stands. Saw-timber volume aggregates 7.6 billion board feet and averages only 1,310 board feet per acre of forest.

Total volume is 72 million cords. Volume of sound growing stock is 57-1/2 million cords -- less than 10 cords per acre.

Pines, chiefly demanded by forest industry, comprise less than 34 percent of cordwood growing stock. Hardwoods, mostly oaks, comprise 66 percent.

Small, young timber predominates. Nearly three-fourths of growing stock is in trees less than 13 inches in diameter.

Limited urban-industrial development requires the majority of the people to depend upon the depleted soil and forest resources for a meager livelihood. Nearly three-fourths of the population is rural.

Forest industry provided 5-3/4 million man-days of employment in 1940 and accounted for more than a fifth of the entire personnel in agriculture, industry, and business.

Lumbering is the main forest industry, with 1,196 mills producing 383 million board feet of lumber in 1940. Most mills are very small and inefficient.

Making fuel wood is also a major forest industry, providing nearly half of all woods and mill employment.

Industrial drain on saw timber in 1940 was 468 million board feet, as compared with current annual growth of 624 million feet (109 feet per acre of forest).

Industrial drain on all growing stock was 144 million cubic feet; growth was 228 million cubic feet (equivalent to 0.60 cord per acre).

However, serious deficits of growth appear in certain localities, especially in saw-timber stands; and growth typically falls short of drain in softwoods and in large-size trees.

Forest industry contributes about one-tenth of all income received by the people of Piedmont Virginia.

But forests' contribution must be made even greater in the future if the people's income is to reach a reasonable level, for the poverty of agricultural resources requires chief hope to be placed in forest and industrial development.

To increase forest income in the face of present forest deterioration will require a revolution in attitudes toward land management.

Principal needs are to curb forest fires and stop destructive cutting so that the forest can be rebuilt, and to correct wasteful inefficiency in timber marketing and utilization.

Section 1. -- INTRODUCTION

Physical Background

The Piedmont of Virginia, a region of hardwood and pine woodlands, extends through the center of the State, between the continuous hardwood forest of the Blue Ridge on the west and the extensive pine areas of the Coastal Plain on the east. Comprising 35 counties, the district is some 200 miles long and tapers in width from over 150 miles along the North Carolina line to 50 miles at the Maryland border (fig. 1). Its land area is a little more than 10 million acres -- two-fifths of Virginia's entire land area -- with nearly 6 million acres in forest.

The Piedmont landscape is characteristically rolling - in contrast with the plain on the east and the rugged mountains on the west. The general land surface rises from about 300 feet above sea level along the eastern border to between 500 and 1,000 feet at the base of the Blue Ridge; and then, in the last 5 or 10 miles between the base and summit of the Ridge, mounts steeply to exceed, in some places, 4,000 feet in elevation (16).[1]

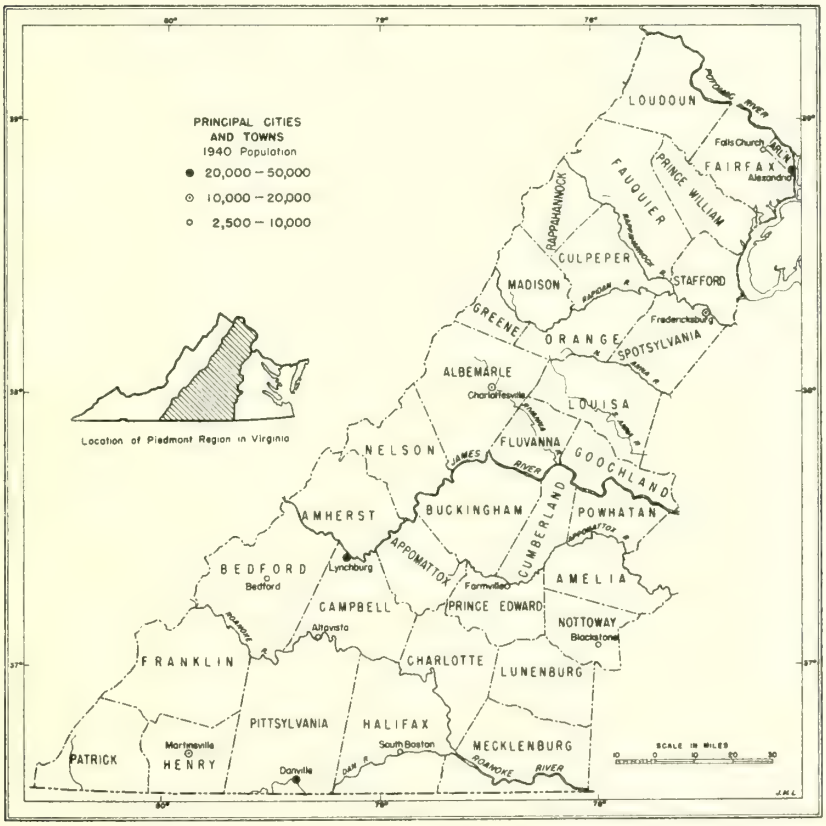

Figure 1. -- Counties, rivers, and principal cities and towns of Piedmont Virginia.

The soils, originally fertile, have lost much of their richness through erosion and heavy cropping. Over extensive sections the soils are clearly submarginal for farming. Their chief hope for the future lies in forest production.

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[1] Underlined numbers in parentheses refer to "Literature Cited", p. 82.

Original Forest

Piedmont Virginia was originally a wilderness of nearly unbroken hardwood-pine forest. In the south, along the eastern border, stands of loblolly pine extended inland from the great pine areas of the Coastal Plain. But with this exception the Piedmont was predominantly -- and over large stretches almost exclusively -- a hardwood country (2, 5, 6).

Four broad types of forest growth predominated: (1) Along the stream margins and bottoms white and northern red oaks, hickory and yellow-poplar made up the bulk of the timber. Other trees were sycamore, sweet-gum, red maple, river birch, and walnut. (2) The lower slopes and moist areas adjacent to streams ran heavily to the white oak-hickory type of forest, with scarlet, black, and red oaks and yellowpoplar the chief associates. (3) On the upper slopes and ridge tops, along with the ever-present hickory, were southern red, black, scarlet, and chestnut oaks; and on the drier ridge tops, blackjack and post oaks. (4) Extending down the mountain slopes and foothills on the west, chestnut and hemlock were found in mixture with the other trees.

This hardwood forest, especially along the slopes and ridges, was patched and dotted with pine -- in the south and east, chiefly shortleaf pine; in the north and west, chiefly Virginia pine. Where fire or other catastrophe had at some time cleared the forest, the pine was to be found in extensive and nearly pure stands. White pine grew in the foothills and mountains at the western border of the Piedmont.

Most of the forest was old growth, with the principal trees large and mature and the quantity of timber amounting to perhaps 12,000 to 14,000 board feet on the typical acre. But all conditions of timber were represented in the district. Fires set by the Indians burned over sizeable areas every year and occasionally damaged or destroyed the old timber, making way for a new succession of brush, saplings, poles, and eventually saw timber.

The total quantity of timber in the original forest was possibly close to 120 billion board feet, of which about one-fourth was pine. In 1940, after 2 centuries of settlement in the district, woods still occupied 60 percent of the total land area, but contained only one-fifteenth as much saw timber as the original forest. The proportion of pine, however, had increased to more than 40 percent.

Tobacco and Land Use

While the first permanent white settlement in Virginia, at Jamestown, was founded in 1607 and during the next few decades the frontier was pushed well back along the principal rivers, it was a hundred years thereafter before the first thin scattering of pioneers established homes in the Piedmont; and it was not until the mid-eighteenth century that the Piedmont began to be opened up extensively (1, 3). The barrier to westward migration presented by the Coastal Plain-Piedmont border was largely a matter of transportation: the border was the fall line, and the falls set a limit to river transport, in those days the only economical means of transport. This barrier was not fully removed until the era of railroad expansion, beginning in 1836 (8).

Behind transportation, again, lay the overwhelming fact of tobacco as the hub of the economic life.

The story of land use -- forest and agricultural -- in early Virginia is essentially the story of tobacco. Tobacco was first planted at Jamestown in 1612 and within a short space of years had gained a dominance over the life of the people which it was slow to relinquish (4). Tobacco production enjoyed a marked advantage over other types of economic activity. One cause of this was the fact that the English and Europeans who emigrated to Virginia brought with them high standards of living acquired in a mature and integrated economic society and were not prepared to descend willingly to a standard of self-sufficient frontier life. Thus they turned eagerly to tobacco production for export, retaining their position in the industrial pattern of the Old World. Again, tobacco-growing demanded much land, but was saving of capital and labor; and these things were scarce, while land was abundant.

But tobacco culture was also wasteful of the soil. The tobacco plants themselves absorbed large quantities of soil nutrients. And even more important in soil wastage was the erosion which followed the hoeing and shallow plowing of that primitive agriculture.

Under this system farm-land fertility was quickly depleted -- and under it arose the land-use cycle of clearing and abandonment which in later years came to typify the agriculture of Piedmont Virginia.

It is true that the first white settlers to clear the Pietmont forest, in the early years of the eighteenth century, necessarily entered upon a self-sufficing, frontier type of agricultural life. But as roads were pushed westward from the Coastal Plain during the second quarter of the century, settlers grasped eagerly this opportunity to gain access to the sea and to tobacco commerce.

Agricultural Development -- Effect on the Forest

In the decades that followed the entrance of commercial agriculture into Piedmont Virginia, transportation systems, population (fig. 2), and tobacco moved westward in successive waves. So essential a part of the agricultural economy and society did the system of land clearing, exploitation, and abandonment become that it persisted long after the Revolution, when wheat and other grains began to shoulder their way into the field of staple crops. So long as there were virgin lands to be had at home and so long as new lands and new agricultural methods were being developed in the west, staple prices were unlikely to rise -- and seldom did rise -- to the point where it paid to use fertilizers and otherwise intensify the farming system. Even in the late 1830's it was only at the northern end of the Piedmont, where markets and transportation were most favorable, that fertilizing and crop rotation had been introduced on a significant scale (4).

Thus a shifting and unstable agriculture continued to characterize Piedmont Virginia. This is the theme of the story of the district's forests and the key to conditions and problems of the present day.

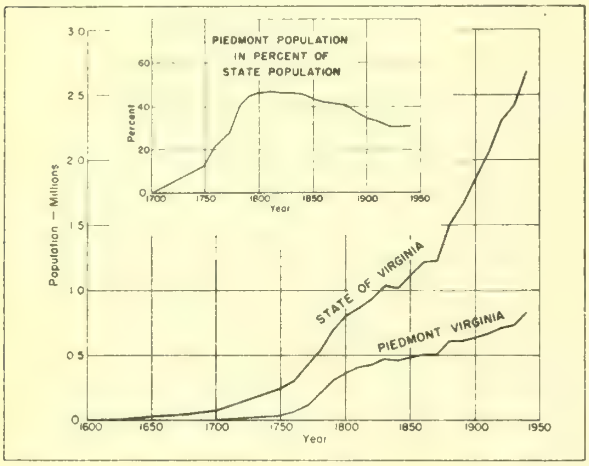

Figure 2. -- Population trends in Piedmont Virginia and the entire State, 1607-1940 (4, 10, 14).

The depleted mineral soils left exposed upon abandoned farm lands furnished favorable seedbeds for pine, but discouraged hardwood reproduction. Seeded in from adjacent scattered trees and clumps (the "forest pines" of the original timber stands), a cover of "old-field" pine developed on these lands. And as the clearing-abandonment cycle continued, the general character of the forest was gradually converted from predominant hardwood to predominant pine. Woods fires, reclearing of once abandoned fields, and generally, the whole migratory character of farming served to further this conversion from hardwood to pine.

During the first half of the nineteenth century the aggregate extent of cleared and improved farm land, which had increased steadily theretofore, reached a nearly stationary level. The migration of agricultural fields in the land-use cycle continued. But it was no longer an expanding agriculture: old land was abandoned as rapidly as new was cleared. After 1850 abandonment began to overtake clearing (fig. 3).

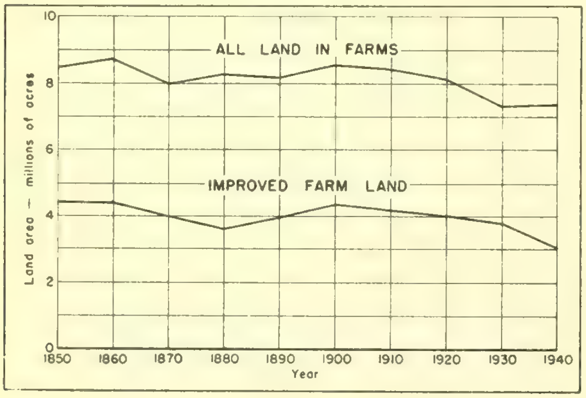

Figure 3. -- Trends in acreage of farms and improved farm land, 1850-1940 (12).

Dwindling of improved farm land, especially after 1900, was a typical phenomenon, save only in the tier of counties along the western border. On the other hand, the area of forest, which had been shrinking continuously before 1850, probably about that time reached a low ebb and has since, with the exception of a short period of farm expansion before 1919, been increasing.

In 1940, farms in the district numbered 73 thousand and occupied 7.4 million acres -- nearly three-fourths of the total land area. Only 3.0 million acres of this land, however, were improved. Today commercial farming is concentrated in two parts of the district (fig. 4). In the south, flue-cured tobacco is still the major crop. In the northwest dairying and fruit growing are common. Over most of the remainder of the district a general or a self-sufficient type of farming prevails. But depleted soils, with their long history of exploitation, afford only poor returns to agriculture. Nearly 45 percent of all farm families received less than $400 of total gross income from products sold, traded or used in 1939 (12).

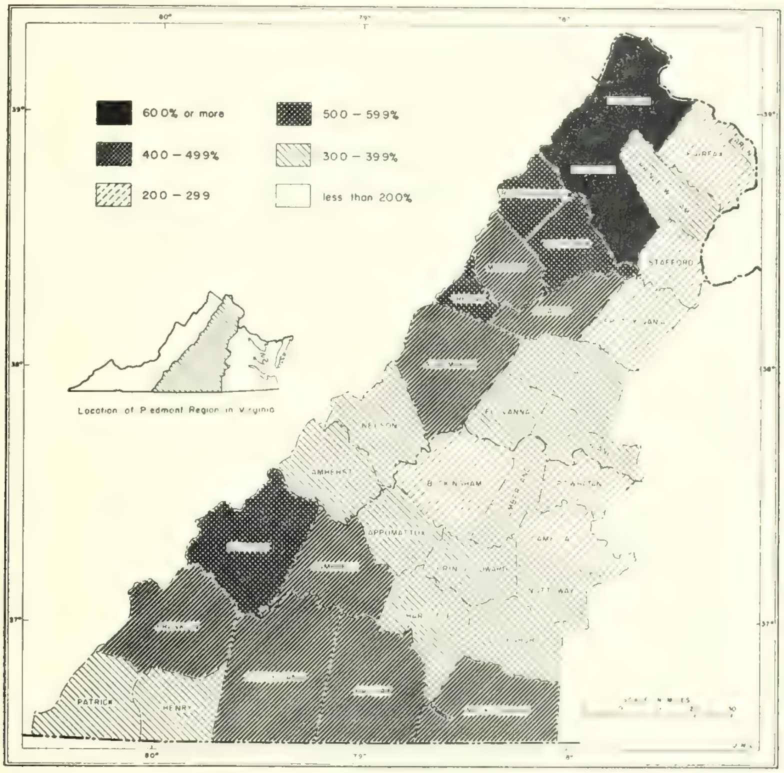

Figure 4. -- Proportion of cleared farm land in the total land area of each county, 1940 (12). (Light cross-hatching, except near District of Columbia, indicates forest concentration.)

With the gradual stabilization of agriculture and suppression of the clearing-abandonment cycle since about 1900, a new change has begun to take place in the woodlands of Piedmont Virginia. The hardwoods of the original forest, especially the predominant oaks and hickories, have invaded the pine stands -- in some places becoming, and in others promising soon to become, the major species. This hardwood invasion has been made possible by the greater permanence of fields and woods. The woods, under better fire protection, have accumulated the layer of forest top soil in which hardwood seedlings can establish themselves and thereafter overtop and dominate the pine. Maintenance of a more or less permanent forest cover, as contrasted with clearing and abandonment, gives the young hardwood an advantage over the pine, which is less able to tolerate shade. Meanwhile continued selection and cutting of the more marketable pine from the mixed stands has steadily increased the proportion of hardwood in the overstory (2).

Development of Forest and Other Industry

In most southeastern coastal states the Piedmont section is the most highly industrialized. But in Virginia the Piedmont is primarily agricultural. With 39 percent of all land in the State, the Piedmont contains 42 percent of the number of farms and 45 percent of the land in farms. Its industrial development is slight as compared with the Coastal Plain. Many Virginia-Piedmont industries are predominantly rural and local in character, their plants, especially in the field of timber processing, being operated on a part-time basis by farmers and other rural workers. Urban population is still greatly in the minority. Only 28 percent of the district's 830,000 population is urban, as compared with nearly 50 percent (of a much larger population) for eastern Virginia. Nearly eight-tenths of all employed persons are engaged in agriculture; while in the rest of the State only about six-tenths are so employed (15).

Indeed it was agricultural, rather than industrial, development which attended the first exploitation of the forest resource. Of the tremendous quantity of timber cut in the course of land clearing during the long period from settlement until the mid-nineteenth century, it appears that the greater portion was destroyed; and of that used, all but a small part was used locally and underwent a minimum of processing. There was little timber industry or trade in forest products, for transportation was too poor and costly, considering that ample timber was still to be had near tidewater.

After the middle of the nineteenth century, when railroads and other improved means of transport began to make themselves felt in the district, and as the timber in many communities became seriously depleted, a commercial forest industry began slowly to develop, based largely upon the supplies of pine. It was an unspectacular industry. There was very little large scale timber cutting or sawmilling. Already patchy and scattered as a result of farm-land clearing and abandonment, the Piedmont woods supported much the same kind of industry that exists today -- a diffuse pattern of small, transient mills fed by little woods operations selecting and gathering their timber here and there -- producing, in total, a surprisingly large quantity of timber products, but leaving the face of the land on the whole unchanged.

In 1822, as reported by the Census of Manufactures, the typical Piedmont Virginia sawmill employed only one or two persons. Even in 1860 the average mill reported only three employees. By 1880 the scale of sawmilling had increased to an average employment of four or five persons, the scale obtaining today. Meanwhile, in the State of Virginia as a whole, the scale of sawmilling continued to rise. By 1890 it had exceeded 9 employees per mill, and in 1909 was nearly 13 (13).

In the same year, 1909, the State of Virginia reached its peak in lumber production, gaining sixth place among the States in output (11). But this peak and this rank among the States were achieved in Tidewater and in the Mountains: lumbering in the Piedmont was continuing in much the same course as it had followed before and has followed since.

Generally speaking, with perhaps the exception of textile manufacture, the other industries of the district have experienced a slow and unspectacular development similar to that of the lumber industry. In 1939 there were only 235 manufacturing and mining establishments with 25 or more employees -- less than one-fourth of all such establishments in the State. The numbers in each type of industry were as follows:

Farm-product and textile industries	99
Forest-product industries	50
Chemical, printing, and other light industry	39
Metal, machinery, and other heavy industry	34
Mines and quarries	13
All industries	235

Chief centers of industrial concentration are Lynchburg, with its wide assortment of factories, particularly textile and clothing mills; the outskirts of Washington, running rather heavily to machinery and transportation equipment; Danville, tobacco and textile center; Martinsville, other towns in northern Henry County, and Rocky Mount, where the furniture industry is massed; Charlottesville and Fredericksburg, textile towns; and South Boston, Farmville, and Bedford, with tobacco and textile manufacture (18).

The development of these industrial centers has had a marked effect upon the distribution of population in Piedmont Virginia, for increasing population has characterized the industrial and better farming districts of the south and west, while stable or declining population has marked most of the remainder of the district. In figure 5, where counties are classified according to population growth, the six areas of most consistent increase mark the location of the six industrial centers with a population of 10,000 or more. All the counties without cross-hatching in figure 4 have shown a constant or declining population in two or more of the past four decades.

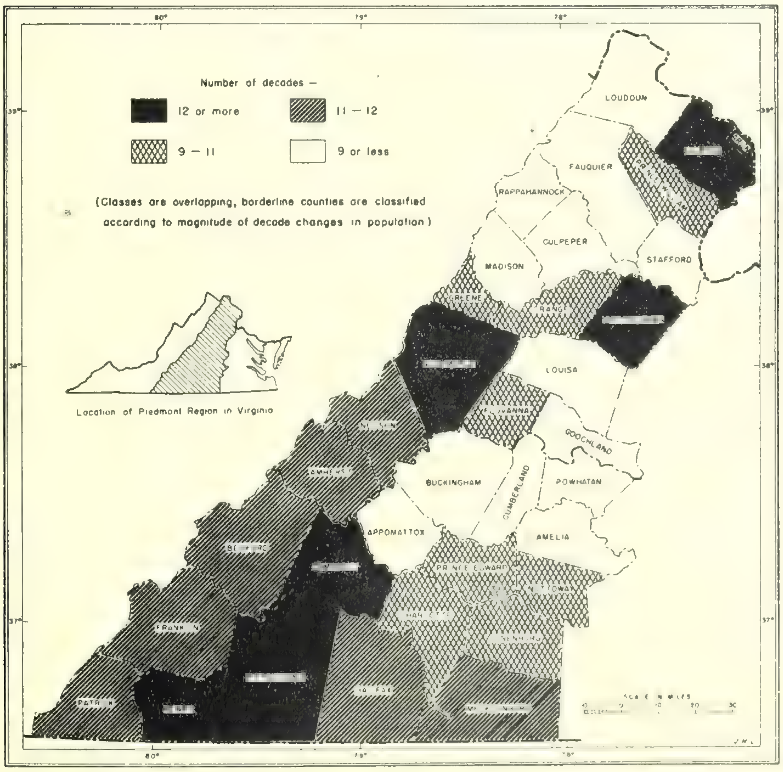

Figure 5. — Number of decades since 1790 in which county population has increased (14).

Section 2. -- THE FOREST -- DESCRIPTION, INVENTORY, GROWTH

Land Use and Forest Ownership

Forests cover nearly 6 million of the 10 million acres of land in Piedmont Virginia. Most of the land not forested -- 3-2/3 million acres of it -- is in farms (fig. 6). Table 11 [2] shows in some detail the use of land -- both in the Piedmont district as a whole and in the two sections lying north and south of the James River.

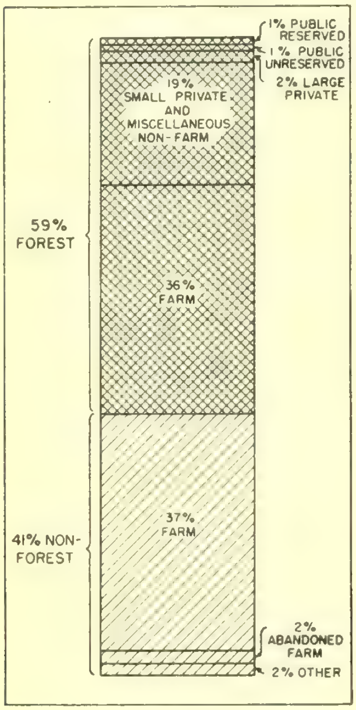

Figure 6. -- Land use and forest-land ownership, 1940.

Farm woodland comprises the major share (61 percent) of the forest; and other small private ownerships, most of the rest (32 percent). Larger industrial forests account for 3 percent of the total area; public forests, 4 percent.

Farm woods have an aggregate area of 3.6 million acres, or 49 percent of all farm land. These woods typically occupy the ridge tops and upper slopes, flanking the pastures and the fields of corn, winter wheat, and tobacco lying adjacent to the narrow valleys. The proportion of farm area in woods is highest in the eastern Piedmont, particularly in the counties south of the James River (table 1 and fig. 7).

The farm woodlands are distributed among nearly 59 thousand farms: four-fifths of the farmers in the district own a portion of the farm-forest resource, the average farmer's share amounting to 55 acres.

Small and miscellaneous private forest holdings other than those in farm ownership aggregate 1,900,000 acres. Individual holdings range in size, for the most part, from a few acres to less than 500. While forest holdings of this type are found throughout Piedmont Virginia, they are notably concentrated along the northeastern belt of poor soils, extending from Fairfax to Campbell County. In this belt, they result from farm abandonment and the reversion of improved lands to forest, a shift which has been taking place at an average rate of 1-1/4 percent annually for the past 30 to 40 years.

Table 1. -- Comparison of woodland areas in Northern and Southern Piedmont, 1940

Descriptive item	Entire Piedmont	Northern Piedmont	Southern Piedmont
Total unreserved forest (M acres)	5,828	2,406	3,422
Farm woodland (M acres).......	3,612	1,266	2,346
Percent of forest on farms........	62	53	69
Land in farms (M acres).......	7,354	2,986	4,368
Percent of farm-land in woods...	49	42	54

Larger forest holdings, of 500 acres or more, in the hands of timber industries, total some 185,000 acres. A relatively minor factor in the forest-ownership pattern, they are confined chiefly to the mountain slopes and foothills of the western Piedmont (the region of old-growth hardwoods) and to the narrow strip of loblolly pine country in the southeast.

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[2] Tables 11 and following are in the Appendix

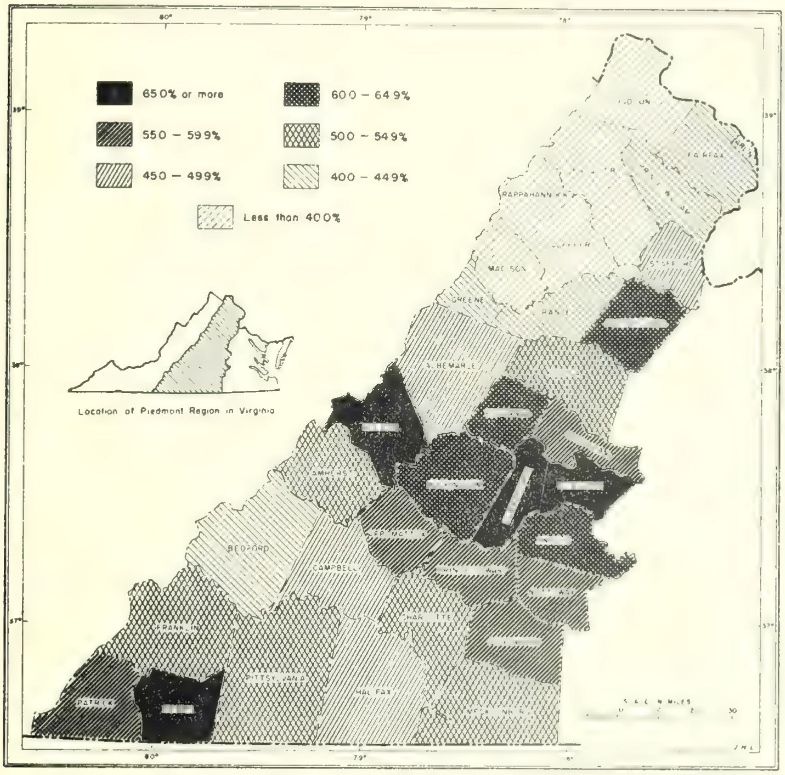

Figure 7. -- Proportion of woodland in the total farm area of each county (12).

About 240,000 acres of forest land is in public ownership -- local, State, and Federal. Small portions of the Jefferson and George Washington National Forests extend from the west into Bedford, Amherst and Nelson Counties, where they include several blocks of mountain-hardwood timber. Five small state forests -- in Buckingham, Appomattox, Cumberland, Prince Edward, and Prince William Counties -- are located mainly upon worn-out farm lands now reverting to forest. The 100,000 acres of forest in the Shenandoah National Park and national monuments and State parks are reserved from cutting and are therefore omitted from consideration in all the following data and discussion regarding forest resources.

Types of Forest -- Location and Extent

The principal types of forest in Piedmont Virginia are the upland hardwoods, accounting for 44 percent of the forest area; Virginia pine-hardwoods, 24 percent; shortleaf pine-hardwoods, 21 percent; and bottomland hardwoods, 6 percent (table 2). The remaining 5 percent of the forest is composed of cove hardwoods, loblolly pine-hardwoods, white pine-hardwoods, and redcedar-hardwoods,[3] none of which exceeds 150,000 acres in extent.

Forest stands are, roughly, half of saw-timber size, half of smaller size. Among the smaller stands cordwood greatly predominates. The inference, however, that Piedmont forests are in a fairly balanced condition as a going concern and are favorably developed for production of sawlogs, pulpwood and other merchantable products is substantially modified, it will be seen, by serious deficiencies in timber quality and stand density.

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[3] See Glossary, p. 54, for explanation of these and other special terms.

The upland-hardwoods type of forest occurs rather generally over the region on drier uplands and low, rolling hills. On the higher lands along the western border the forest is almost exclusively of this type and may be designated, here, as the "mountain-hardwoods" type. Figure 8 indicates the general location of major types of forest. No attempt has been made to show non-forest uses, or to show the patches of intermingled forest types as they actually occur on the ground. For this reason the presence of upland hardwoods east of the foothills is not indicated.

Table 2. -- Forest area, by forest type and condition class, 1940[1]

Forest type	All conditions		Saw-timber stands	Cord-wood stands	Repro-duction stands
	M acres	Percent	M acres	M acres	M acres
Upland hardwoods........	2,587.1	44.4	1,189.7	1,272.1	125.3
Virginia pine-hardwoods.	1,391.5	23.9	474.5	731.2	185.8
Shortleaf pine-hardwoods	1,216.6	20.9	680.8	476.0	59.8
Bottom-land hardwoods...	334.1	5.7	192.5	129.6	12.0
Other types............	298.6	5.1	173.2	99.1	26.3
All types..............	5,827.9	100.0	2,710.7	2,708.0	409.2

[1]/See also table 12.

In all upland-hardwoods stands, 93 percent of the total quantity of wood, measured in cubic feet, is in hardwood trees, and two-thirds of this is oak (table 13). Typical oaks are the scarlet, black, white, chestnut, northern red, southern red, and post oaks. The moister and more fertile sites encourage yellow-poplar and, toward the east, sweetgum; while the very dry, infertile ridges run heavily to oak and hickory.

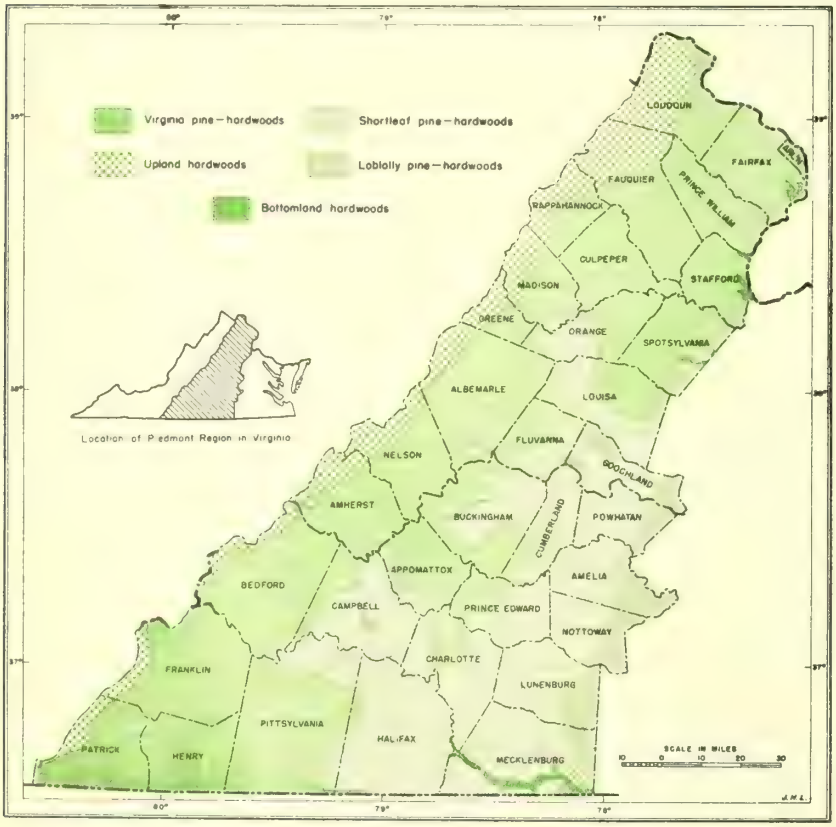


Figure 8. -- Major forest types.

The extent of the different stand conditions -- saw timber, cordwood, and reproduction is illustrated for the upland-hardwoods type in figure 9, and for the other types in figures 10 through 16.

The Virginia pine-hardwoods type occurs rather generally in the Northern Piedmont (north of the James River) and in the western part of the Southern Piedmont, extending into the foothills up to altitudes of 1,000 feet or more. The type includes a considerable acreage of nearly pure pine stands, and on about 50 percent of the total area hardwoods make up less than a fourth of the number of dominant trees. The average stand is 72 percent softwood (in terms of cubic feet); of this softwood, 85 percent is Virginia pine, 14 percent shortleaf pine. Oaks, hickory, yellowpoplar and sweetgum are the chief hardwoods.

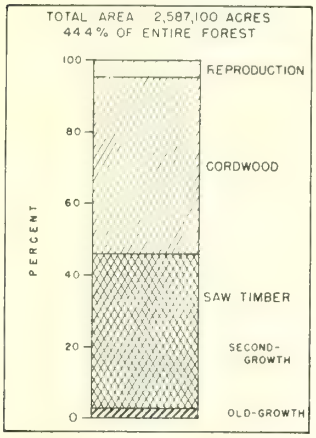


Figure 9. -- Extent of forest conditions in the upland-hardwoods type.

The Virginia pine type is the characteristic forest to invade worn-out old fields and burned-over areas in the northern and western Piedmont. Virginia pine reproduces aggressively. At 10 years of age or earlier, trees begin to bear fair annual crops of seed. Short, crooked, limby, and short-lived, however, this pine is the least desirable of the Piedmont pines. Stands begin to break up at 40 to 60 years, by which time a scattering of hardwoods has usually taken possession of the ground. The result, often is conversion of the forest to the upland-hardwoods type.

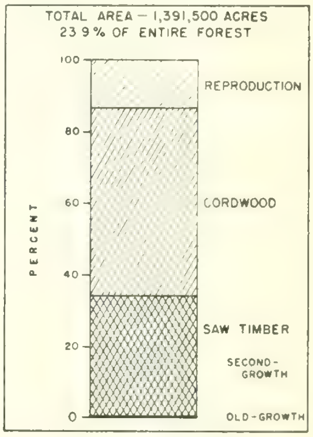


Figure 10. -- Extent of forest conditions in the Virginia pine-hardwoods type.

The shortleaf pine-hardwoods type, on the other hand, is the Piedmont's chief lumber type. Its range is confined largely to the eastern half of the Southern Piedmont, with a limited extension into the southeastern corner of the Northern Piedmont.

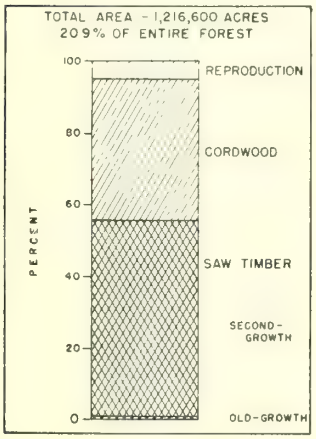


Figure 11. -- Extent of forest conditions in the shortleaf pine-hardwoods type.

A better-formed tree than Virginia pine, shortleaf pine is, however, much less aggressive in its reproducing habits. But its more rapid height growth and longer life permit it to win out on the better sites. Within its range it fills much the same position in old-field and hardwood succession as does Virginia pine farther north and west.

The typical shortleaf pine-hardwood forest is about seven-tenths pine and three-tenths hardwood, with shortleaf pine comprising 88 percent of all the pine (measured in cubic feet) and Virginia pine, most of the remainder. Hardwood composition is similar to that associated with Virginia pine.

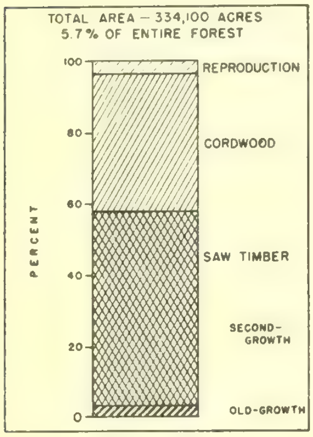


Figure 12. -- Extent of forest conditions in the bottomland-hardwoods type.

The bottomland-hardwoods type occurs along river and stream margins and bottoms, particularly in the broader valleys to the east. Oak is here a minor species, but several of the region's most valuable veneer and lumber hardwoods are common. Yellowpoplar and sweetgum constitute about one-third of the stand and are distinctly more prominent than any other trees. The remainder is composed of a great variety of trees, among which ash, red maple, sycamore, birch, willow, cottonwood, water and willow oaks, elm, holly, and white oak occur most frequently.

The cove-hardwoods type is confined to the western belt of mountains and foothills. There it is found on the deep, moist soils of the lower slopes and stream coves, chiefly those facing in a northerly or easterly direction.

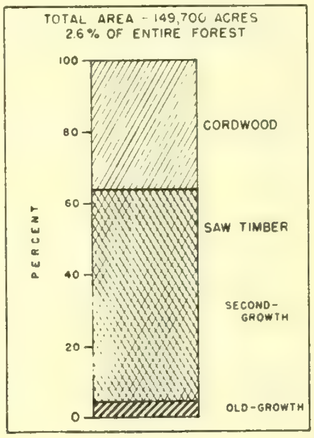


Figure 13. -- Extent of forest conditions in the cove-hardwoods type.

Yellowpoplar -- favored for veneer, lumber, and small dimension stock -- is the most important tree, constituting more than half of the average stand. Northern red oak, one of the best of the red oaks, with its good form, rapid growth, and clean lower stem, is next in rank. White and chestnut oaks, hickory, dogwood, red maple, ash, and hemlock each comprise 2 percent or more of the stand.

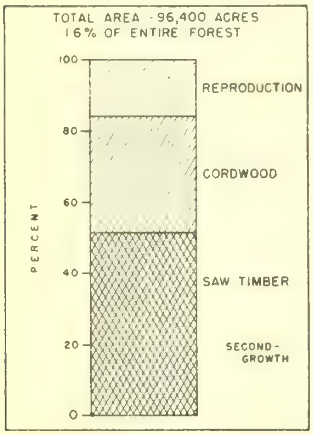


Figure 14. -- Extent of forest conditions in the loblolly pine-hardwoods type.

The loblolly pine-hardwoods type occupies a narrow belt along the eastern edge of the district in the south. A highly prized timber tree, fast-growing in both height and diameter, the loblolly pine is nevertheless of minor interest in the Piedmont because of its limited range.

Nearly three-fourths of the stand is pine and nearly two-thirds, loblolly pine. Shortleaf pine is the chief associate. Among the hardwoods sweetgum, yellowpoplar, white oak, and red oaks are outstanding.

The white pine-hardwoods type is limited almost entirely to Patrick County, in the southwest, where it represents the eastern fringe of more extensive areas of white pine in the mountains. The white pine, itself, makes up 43 percent of the stand, and other pines and hemlock, 16 percent -- leaving a balance of hardwoods, chiefly oaks, of 41 percent.

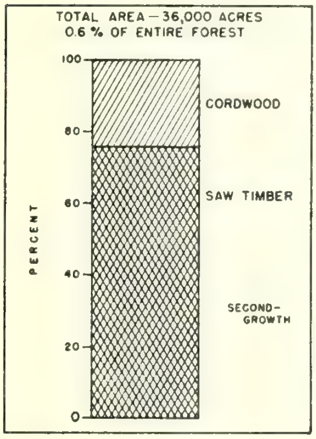


Figure 15. -- Extent of forest conditions in the white pine-hardwoods type.

The redcedar-hardwoods type is largely confined to the Northern Piedmont. The type is found -- usually in small scattered patches -- on dry, limestone ridges and hilltops in the west. Not included here are the red-cedar hedgerows or the scattered trees so commonly left in pastures for shade.

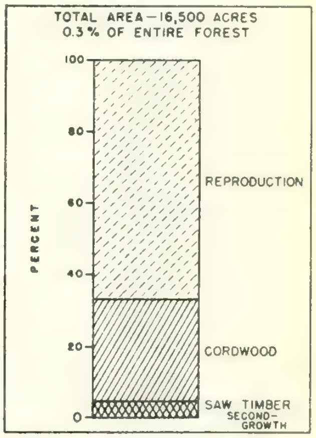


Figure 16. -- Extent of forest conditions in the redcedar-hardwoods type.

Quality and General Condition of Forest Stands

While some timber stands in the district are in good, productive condition, yet by and large the forests present a picture of abuse and decadence -- fire and pest damage, overcutting, and general poor management.

Some of the more hopeful aspects of the situation are these: a total area of second-growth saw-timber stands not recently cut over amounting to 2 million acres, 35 percent of all the forest -- about 100,000 acres of old-growth stands -- a considerable acreage (partly included with the uncut stands) of old-field pine which originated in the land-abandonment crisis after 1920 and now supports well stocked pulpwood and small sawlog timber. Furthermore, a small but apparently increasing proportion of farmers and other woods owners are making a conscious effort to practice forest management for sustained income.

But against these hopeful aspects, and greatly outweighing them, are the factors responsible for widespread forest deterioration.

Forest fire is possibly the most serious of these. Nearly a fourth of the forest shows evidence of fire, and 13 percent of all stands are markedly damaged. Many fires kill the timber; others burn the base of the trees, opening the way for the entrance of rot. Fire injury is especially great in saw-timber stands of the hardwood types and of shortleaf pine.

Furthermore, when they are weakened by fire or other destructive agencies, trees are laid open to attack by insects, such as the hickory bark beetle, oak pin-hold borers, and southern pine beetle. The pine beetle has been particularly destructive across the central part of the district. Another insect, the locust borer, has virtually stopped the planting of black locust, a valuable tree for erosion control and for fence posts and other products.

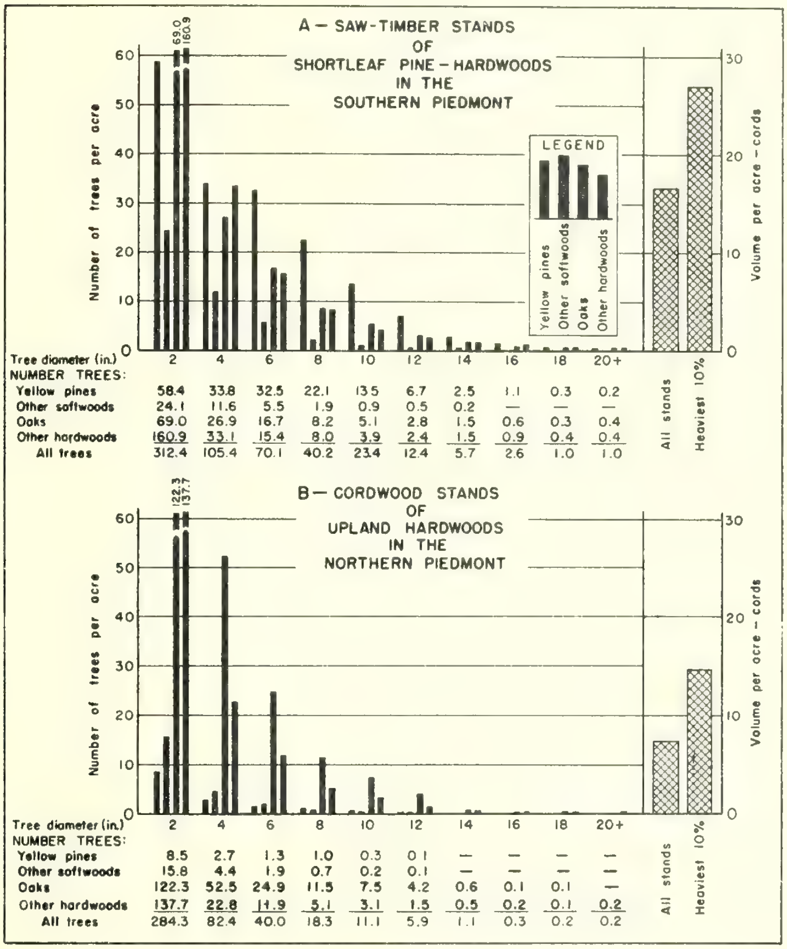
Equal responsibility, along with fire, for depleted forests falls upon the practices used in harvesting timber -- heavy cutting, with no provision for regenerating the valuable kinds of trees; and the creaming process, wherein the pines and a few favored hardwoods are cut, leaving a thin stand of culls and undesirables in possession of the ground. Such practices arise largely as a part of the whole farm-woods problem -- the scattered ownership pattern; the indifference of farmers, especially tenants, to the forestry side of their business; lack of contact with satisfactory timber markets; uncontrolled stumpage sales to contractors and others whose only interest in the woods is maximum immediate profit.

The prevalence of heavy cutting is reflected in the present age of timber stands. Short timber rotations, the predominance of fuel wood as a forest product, generations of farm clearing and hit-or-miss restocking of timber have created a predominantly young forest. The average age of saw-timber stands of pine is about 40 years; of upland hardwoods, about 70 years. The entire forest averages only 39 years of age, with less than 5 percent of the stands 100 years or older.

Finally, along with forest depletion has gone the depletion of forest sites through woods burning, soil erosion, and destructive cropping. It has been estimated (19) that 90 percent of all Piedmont-Virginia soils are subject to moderate or serious sheet erosion. Perhaps partly as a result of deteriorated sites, the little-leaf disease of pine has invaded the district, and is now prevalent in the belt of counties from Charlotte to Louisa (9).

A picture of two forest stands typical of Piedmont Virginia appears as figure 17. While there is a fair stocking of very small-size trees, the numbers of trees, even in the saw-timber stand, drop off rapidly above 6 inches. In saw-timber stands of the shortleaf pine-hardwoods type in the section south of the James River the total quantity of wood, in cords, in trees 6 inches and larger in diameter is only about 61 percent of reasonably full stocking, as judged by the densest 10 percent of the stands. A similar comparison for the upland hardwoods of the Northern Piedmont shows only 49 percent stocking. This is essentially what is to be found throughout the Piedmont forest, where the average stocking of timber in cordwood and saw-timber stands runs about 47 percent of that in the heaviest stocked 10 percent for pine types, 51 percent for hardwood types.

The secondary position of pine and other softwoods and the prominent place held by the less desirable species, even in softwood types of forest, is illustrated also in figure 17, even though the considerable number of cull trees in these stands has not been shown. In the shortleaf-pine forest, hardwoods -- chiefly oaks, sweetgum, persimmon, ironwood, and hickory -- dominate the understory, further evidence of the aggressiveness of hardwood reproduction under forest conditions. Hardwoods predominate, also, among the largest trees, the result of heavy cutting of pines in these sizes.



A

Tree diameter (in.)	2	4	6	8	10	12	14	16	18	20+
NUMBER TREES:										
Yellow pines	58.4	33.8	32.5	22.1	13.5	6.7	2.5	1.1	0.3	0.2
Other softwoods	24.1	11.6	5.5	1.9	0.9	0.5	0.2	—	—	—
Oaks	69.0	26.9	16.7	8.2	5.1	2.8	1.5	0.6	0.3	0.4
Other hardwoods	160.9	33.1	15.4	8.0	3.9	2.4	1.5	0.9	0.4	0.4
All trees	312.4	105.4	70.1	40.2	23.4	12.4	5.7	2.6	1.0	1.0

B

Tree diameter (in.)	2	4	6	8	10	12	14	16	18	20+
NUMBER TREES:										
Yellow pines	8.5	2.7	1.3	1.0	0.3	0.1	—	—	—	—
Other softwoods	15.8	4.4	1.9	0.7	0.2	0.1	—	—	—	—
Oaks	122.3	52.5	24.9	11.5	7.5	4.2	0.6	0.1	0.1	—
Other hardwoods	137.7	22.8	11.9	5.1	3.1	1.5	0.5	0.2	0.1	0.2
All trees	284.3	82.4	40.0	18.3	11.1	5.9	1.1	0.3	0.2	0.2

Figure 17. -- Numbers of trees and total quantity of wood per acre in two typical forest stands.

Quality of Forest Sites

Judged by standards of site quality for the southeastern United States, or even by conditions in adjoining districts to the east and south, the quality or productivity of forest lands in Piedmont Virginia is low. For all pine and pine-hardwood stands, the average height of dominant pines at 50 years (site index) is 57 feet, as compared with 61 feet for the Piedmont district of North Carolina and 67 feet for coastal Virginia. As table 3 shows, only one-fifth of the pine forest is on 70-foot or better sites.

Forest site, measured in terms of pine productivity, reveals a rather well defined geographical pattern within the district, improving toward the south and toward the east (fig. 18). In general, there is little relation between pine-site quality and the productivity of the soils for agriculture.

Table 3. — Proportion of site classes in the pine and pine-hardwood forest

Site-index class (feet)	Percent of area
40	8
50	36
60	36
70	15
80	4
90	1
All sites	100

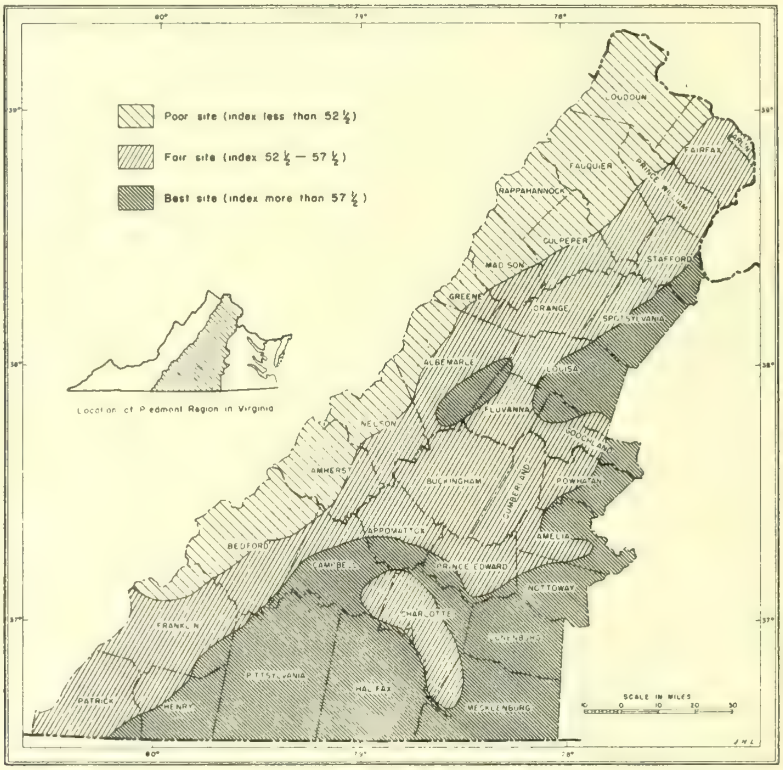


Figure 18. -- Location of three generalized site classes of forest land, based upon height growth of shortleaf and Virginia pines.

Quantity of Saw Timber in Board Feet

The total quantity of timber in sound trees of sawlog size in Piedmont Virginia is 7.6 billion feet, board measure -- an average of 1,310 board feet per acre of forest land (table 17). With 40 percent of the State's forest area, the Piedmont contains only 31 percent of the saw timber, the average stocking per acre being nearly one-fourth less than that for the State as a whole. Again, average stocking per acre in Piedmont Virginia is less than 60 percent of that in Piedmont North Carolina.

About four-tenths of the total board-foot volume is in pine timber. Ninety-five percent of the total is in stands of saw-timber size, the remainder occurring in isolated trees scattered through cordwood and reproduction stands (table 4).

Greater forest area and a 23 percent heavier stocking of saw timber in the Southern Piedmont put nearly two-thirds of all the saw timber in this section. Volumes of the major lumber species -- loblolly and shortleaf pines and yellowpoplar -- are heavily concentrated in the Southern Piedmont.

Table 4. -- Board-foot volume, by tree species and forest condition, 1940[1]

Tree species	All conditions		Saw-timber stands	Nonsaw-timber stands
	Million bd. ft.	Percent	Million bd. ft.	Million bd. ft.
Softwoods:				
Shortleaf, loblolly pines	1,973.9	26.0	1,861.1	112.8
Virginia pine	1,058.4	13.9	966.7	91.7
Other softwoods	116.6	1.5	108.0	8.6
All softwoods	3,148.9	41.4	2,935.8	213.1
Hardwoods:				
Northern red oak	437.7	5.8	430.7	7.0
Other red oaks	686.5	9.0	649.6	36.9
White oaks	1,261.7	16.6	1,199.8	61.9
Red maple	108.4	1.4	101.0	7.4
Sweetgum	243.3	3.2	233.4	9.9
Yellowpoplar	1,002.2	13.2	963.9	38.3
Hickory	254.6	3.3	239.1	15.5
Other hardwoods	467.1	6.1	444.0	23.1
All hardwoods	4,461.5	58.6	4,261.5	200.0
All species	7,610.4	100.0	7,197.3	413.1

[1] See also tables 14 and 15.

The contribution of the different sizes of trees to the total quantity of saw timber in the district appears in figure 19. This figure reveals clearly the predominance of small-size trees. Two-thirds of the quantity of softwood timber is in trees of the two smallest merchantable diameter classes, the 10- and 12-inch classes; and 36 percent is in the 10-inch class alone. In the case of hardwoods the two smallest diameters assigned board-foot volume, the 14- and 16-inch classes account for 44 percent of the timber volume; and the 14-inch class alone, 25 percent. Only 8 percent of all timber is in trees 26 inches and larger in diameter.

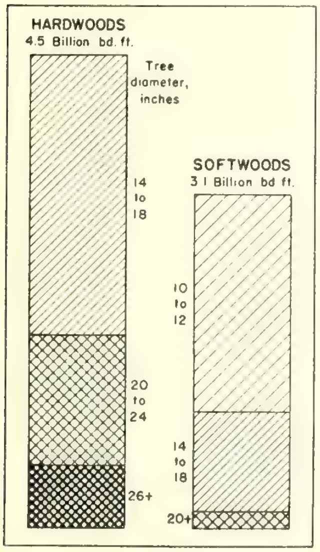


Figure 19. -- Distribution of total quantity of saw timber by tree diameter (see also table 16).

Further commentary on the small diameter and poor stocking of saw-timber stands is suggested by the fact, illustrated in figure 20, that more than half of all such stands contain less than 2,000 board feet of saw timber per acre; and that only about 7 percent of them contain 6,000 board feet or more. It is true that the distribution of the quantity of saw timber presents a somewhat more favorable picture, with

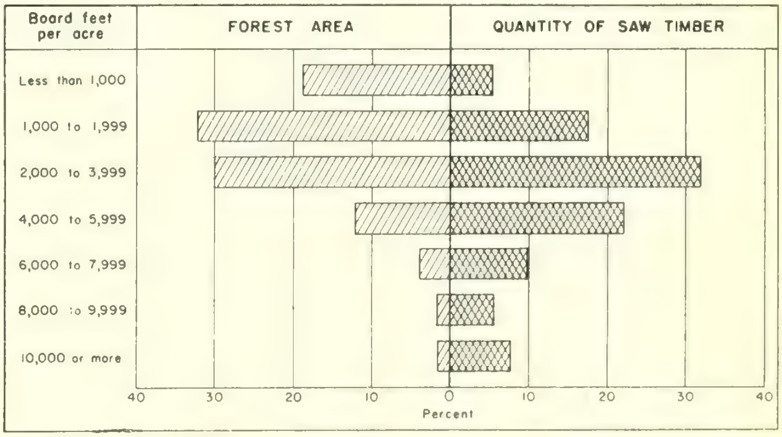


Figure 20. -- Distribution of forest area and quantity of saw timber in saw-timber stands, by timber-density class.

more than three-fourths of all saw timber occurring in stands of 2,000 board feet or more per acre. However, the averages of figure 20 apply to the fourth-acre patches of forest that comprised the Forest Survey inventory sample, and not to entire blocks of timber. Consequently logging chances on any 50-acre farm woodland or 500-acre commercial property are more likely to approach average -- 1,000 to 2,000 board feet per acre -- than figure 20 suggests.

Quantity of Wood in Cords

The sawlog component of Piedmont-Virginia forests represents less than one-third of the total cubic quantity of wood in trees 5 inches and larger in diameter. The greatest share of this total volume -- approaching one-half of it -- is contributed by trees of less than sawlog size (cordwood trees). Cull trees and upper stems of sawlog trees account for additional amounts (table 5). This small and low-grade material is an important source of such products as pulpwood, fuel, fence posts, and substandard sawlogs.

Table 5. -- Cordwood volume, by tree species and type of material, 1940[1]

Tree species	All material	Saw-timber trees		Cordwood trees	Cull trees
		Sawlog material	Upper stems		
	M cords	M cords	M cords	M cords	M cords
Softwoods:					
Shortleaf, loblolly pines	13,484.6	5,812.5	1,640.3	5,745.8	286.0
Virginia pine	8,895.6	2,702.2	872.3	4,342.3	978.8
Other softwoods	621.4	264.1	53.6	269.6	34.1
All softwoods	23,001.6	8,778.8	2,566.2	10,357.7	1,298.9
Hardwoods:					
Northern red oak	2,732.7	1,055.0	663.0	695.6	319.1
Other red oaks	7,710.9	1,987.2	1,078.3	3,933.4	712.0
White oaks	15,609.4	3,709.7	2,022.8	7,897.5	1,979.4
Red maple	2,191.4	298.5	171.6	899.8	821.5
Sweetgum	2,650.2	590.5	351.9	1,538.7	169.1
Yellowpoplar	8,237.1	2,707.4	1,470.3	3,485.7	573.7
Hickory	3,122.0	823.6	434.4	1,618.1	245.9
Other hardwoods	7,421.7	1,282.8	738.9	3,367.3	2,032.7
All hardwoods	49,675.4	12,454.7	6,931.2	23,436.1	6,853.4
All species	72,677.0	21,233.5	9,497.4	33,793.8	8,152.3

[1] See also tables 18 and 19 and fig. 21.

Not included in table 5 are some 2.9 million cords of blight-killed chestnut still standing along the western border of the district, 2.2 million cords of it in trees 13 inches and larger in diameter. Besides its use for fuel, posts, and lumber, the dead chestnut of this area provides raw material for three plants manufacturing tannin extract, and for one pulp mill

The cordwood inventory, which includes both hardwood and softwood trees 5 inches and larger in diameter, reveals more clearly than the board-foot inventory the predominance of hardwood timber in the district. About 49-2/3 million cords, or 68 percent of total cordwood volume, is hardwood. In the Northern Piedmont, hardwood comprises 76 percent of cordwood volume; in the Southern Piedmont, 63 percent. Of this great quantity of hardwood, oaks make up 52 percent; yellowpoplar, 17 percent. These two hardwoods -- together with the two chief softwoods, shortleaf and Virginia pines -- account for more than three-fourths of the total volume in cords.

As regards tree diameter, nearly three-fourths of cordwood growing stock (excluding cull trees and hardwood tops) is in trees of small size, less than 13 inches in diameter. More than a third of it is in 8-inch and smaller trees (table 20).

The 57-1/2 million cords of wood in sound growing stock represents an average of 9.9 cords per acre of forest land (table 21) -- a poorer average stocking than is found in adjoining districts, both in Virginia and in North Carolina.

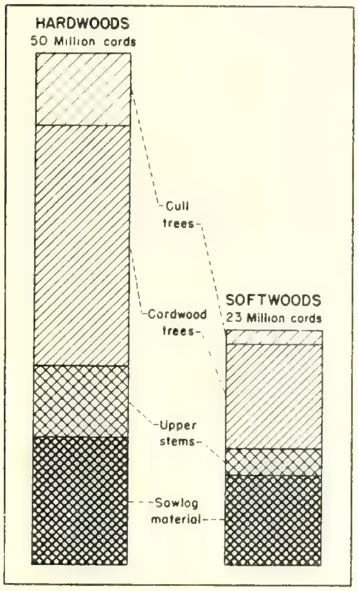


Figure 21. -- Distribution of total quantity of wood in cords, by type of material.

Quantity of Forest Products -- Summary and Appraisal

The inventory of timber resources in Piedmont Virginia has brought out a number of striking characteristics of the forest: a preponderance of hardwood, suitable chiefly for the lower-value uses -- a deficiency of large-size timber usable for veneer and sawed products -- a high proportion of those classes, grades, and species of timber avoided in all but fuelwood cuttings. In the last analysis, any appraisal of the capacity of the district's forests to produce income for its people must be based upon an inventory of the actual, usable timber products that are or will become available for harvest -- for only as they may be converted to sawlogs, pulpwood, fuel wood, and other real products do the board feet and cords of forest timber take on meaning as a source of livelihood.

The highlights of such an inventory are presented as table 6, which shows the quantity of material suitable for each of a few key uses, and the relation of this quantity to the total amount of wood available for all uses. No attempt has been made to assign each kind of timber exclusively to one use, and hence there is some duplication in the table which must be kept in mind in interpreting it. For example, the material shown as suitable for veneer logs and crosstie bolts is included also in the inventory of sawlogs. From this it follows that the percentages in the last column of table 6 add to more than 100.

Nearly three-fourths of the timber in the district is of a type suitable primarily for fuel wood, although some of this same timber is also usable for pulpwood. (Much of it probably has its highest use as growing stock, to be reserved for future production of larger-size timber). On the other hand, the small proportion of timber suitable for veneer logs, cross-tie bolts, specialty products, and poles is striking.

Table 6. -- Volume inventory of timber resources, according to type of material or typical use, 1940

Type of material	Typical use	Total volume	
		In units of measure	In percent of total forest inventory
Yellowpoplar, white oak, etc. logs 16" and larger	Veneer logs	630,600 M bd. ft.	2
Loblolly, shortleaf, white pine, hemlock saw timber	Favored softwood sawlogs	2,071,200 M bd. ft.	10
Virginia pine saw timber	Other softwood sawlogs	1,058,400 M bd. ft.	5
Hardwood saw timber	Hardwood sawlogs	4,461,500	17
Oak logs 12" and larger	Cross-tie bolts	40,962 M pieces	7
All cedar and specialty woods	Specialty products, fence posts	834 M cords	1
Straight, clear loblolly, shortleaf, Virginia pine	Poles	18,923 M pieces	3
Yellow pine small trees, large tops, usable culls	Softwood pulpwood	14,283 M cords	19
Hardwood ditto and standing dead chestnut	Hardwood pulpwood	9,260 M cords	12
All small trees, tops, culls of fuel-wood species	Fuel wood	53,773 M cords	72

Growth of Forest Stands

The current annual net growth of timber in Piedmont Virginia -- that is, the amount by which growing stock was expected to increase during 1940, with allowance for tree mortality but before deduction for cutting - is 625 million board feet of saw timber, or 3.4 million cords of all material (tables 22, 23, and 24). This total net growth represents an average of 109 board feet or six-tenths of a cord per acre of forest -- 8.2 and 5.9 percent, respectively, of growing stock. The net growth is proportioned among the various kinds of trees as follows, in percent:

	Percent of saw-timber growth	Percent of growth of all material
Shortleaf, loblolly pines	25	22
Virginia pine	21	22
Other softwoods	1	1
Oaks	25	25
Gums and yellowpoplar ...	20	18
Other hardwoods	8	12
All species	100	100

And the percentage of net growth in each condition of forest stands is --

	Percent of saw-timber growth	Percent of growth of all material
Saw-timber stands	72	54
Cordwood and reproduction stands	28	46
All stands	100	100

The proportion of net growth contributed by softwoods is markedly greater than the proportion of softwoods in the growing stock itself: the board-foot growth of these trees amounts to 9.3 percent of growing stock, as compared to 7.6 percent for hardwoods. The corresponding percentages for growth in total volume are 7.4 for softwoods, 5.2 for hardwoods.

Table 7. -- Current annual net growth per acre, by forest type and condition, 1940[1]

Forest type	Saw-timber stands		Cordwood and reproduction stands	
	Bd. ft.	Cord	Bd. ft.	Cord
Loblolly pine-hardwoods.	262	0.98	31	0.38
Shortleaf pine-hardwoods	176	0.79	55	0.60
Virginia pine-hardwoods.	182	0.79	60	0.56
Bottom-land hardwoods...	183	0.79	59	0.52
Cove hardwoods..........	240	0.88	108	0.80
Upland hardwoods........	145	0.58	55	0.44
All types..............	168	0.70	57	0.51

[1] See also table 25.

However, rates of growth for both hardwoods and softwoods are relatively high. The 145 board feet per acre per year growth in saw-timber stands of the upland-hardwoods type (table 7) exceeds by more than 10 percent the corresponding rate for Piedmont North Carolina, where this forest type is also of major importance. And there are a number of other isolated cases in which the growth rate of Piedmont-Virginia woods exceeds that in the districts to the south and east. While the over-all average growth falls short of the growth in these neighboring districts, it is nevertheless true that, considering the depleted condition of forest sites and growing stock, productivity in terms of growth is at a high level.

Two factors, chiefly, contribute to the rapid growth of Piedmont-Virginia forests. The typical stands of small-size and rather poorly stocked timber are in optimum position to increase existing volume rapidly with a minimum tree-mortality loss. Following from this, and even more important to rapid growth in most stands, is the great number of trees just below merchantable size, having, initially, no volume; the recruitment of such trees into the ranks of merchantability during each growing season increases the growth of the stand by the entire amount of their final volume. Of the 168-board-foot growth per acre in saw-timber stands, 86 board feet, or a little more than half, is due to recruitment of small trees, and more than 90 percent of board-foot growth in nonsawtimber stands is recruited volume. While recruitment is less a dominant factor in growth of all material, it still accounts for more than one-third of the net growth of all stands in cords.

This, then, is one vital reservation in interpreting optimistically the high growth rates in the district: a major share of the new wood added each year to forest inventory is added on the very smallest trees classed as merchantable. Another reservation, suggested in table 7, is that the fastest-growing types of forest, the loblolly pine-and cove hardwoods, are of the least extent in the district, throwing the least weight into the determination of sum-total net growth. Finally, the very fact that Piedmont forests are now producing new wood at a high, and indeed at near their maximum, rate limits strongly the possibilities for future improvement. If growing stock were to be increased four- or five-fold -- an easily conceivable goal of forest management -- it is doubtful that the accompanying increase in the quantity of growth would be more than 25 to 50 percent. While there is opportunity for improving the composition of growth with respect to sizes and kinds of trees, the total amount of net growth promises to be limited for an indefinite period: soil and climate, the fundamental determinants of growth, can produce just so much, and no more.

Section 3. -- TIMBER CONSUMPTION AND FOREST INDUSTRY

Commodity Drain

From the forest resource and the yearly quantities of new wood produced, is taken an annual harvest of timber for many purposes. This harvest, in 1940, amounted to nearly 470 million board feet of sawlog material, or 144 million cubic feet of all sound material [4/] (tables 26 and 27).

Of the drain of all sound material, 82 million cubic feet, or nearly six-tenths, is taken in the form of sawlogs for production of lumber, timbers, and ties. Next in importance is fuel wood, 36 million cubic feet, or about one-fourth. One-tenth, about 16 million cubic feet, goes into pulpwood. The percentages of total drain accounted for by the various forest products are as follows:

	Percent
Sawlogs	57
Fuel wood	25
Pulpwood	11
Fence posts	2
Veneer logs	2
Hewn-tie bolts	1
Cooperage bolts	1
All others	1
Total	100

Nearly three-fourths of the total commodity drain from Piedmont forests is taken from the section south of the James River. In that section the annual drain amounts to 30 cubic feet per acre of forest land, 4-1/2 percent of the growing stock; while in the Northern Piedmont the drain is 17 cubic feet per acre, 2-3/4 percent of growing stock. This high rate of drain in the Southern Piedmont reflects in part the greater agricultural development there -- the greater use of fuel wood, particularly in tobacco curing, and the more intensive activity of the farm-sawmill industry. In part, also, it reflects the greater extent of more mature stands in the Southern Piedmont and the greater productivity of the forest, emphasized by the prevalence of shortleaf pine, the Piedmont's principal lumber tree.

Shortleaf pine, indeed, together with a small proportion of loblolly pine, accounts for some 62 million cubic feet of the total drain for all commodities in Piedmont Virginia: more than the sum of the two groups of trees next in importance, Virginia pine and oaks. Following are the percentages of total drain derived from the various groups of trees:

[4/] See Glossary, p. 54, for explanation of these and other special terms. It will be noted that "drain" includes only wood cut from growing stock: drain does not include products harvested from cull trees or hardwood tops.

	Percent	
Shortleaf and loblolly pines	43	65 percent softwood
Virginia pine	21	
Other softwoods	1	
Oak	19	35 percent hardwood
Gum and yellowpoplar	11	
Other hardwoods	5	
Total	100	

In the northern Piedmont, Virginia pine, shortleaf pine, and oak account for about equal shares of the total drain; while in the Southern Piedmont shortleaf pine is predominant.

As regards tree size, the apportionment of total cubic-foot drain among the different tree-diameter classes is as follows:

	All trees percent	Softwood trees percent	Hardwood trees percent
6-, 8-inch trees	18	18	19
10-, 12-inch trees	39	45	28
14-, 16-, 18-inch trees ...	32	31	33
20-inch and larger trees ..	11	6	20
Total	100	100	100

These percentages hold approximately for the individual sections of the Piedmont, save that in the Southern Piedmont the drain, like the inventory, shows slightly greater concentration in the largest-size timber; and in the Northern Piedmont, slightly less.

The total saw-timber drain of nearly 470 million board feet represents an average of 80 board feet per acre of forest land, which is 6 percent of growing stock (in the Northern Piedmont, 50 board feet, 4-1/3 percent; in the Southern Piedmont, 102 board feet, 7-1/4 percent). More than three-fourths of board-foot drain is represented by sawlogs, and about one-half of it by shortleaf pine.

Growth and Drain Compared

For the entire forest of Piedmont Virginia, this drain is more than covered by growth, the growing stock increasing during 1940 by 156 million board feet or 84 million cubic feet. The balance of growth and drain during that year was as follows:

	Million bd. ft.	Million cu. ft.
Beginning inventory	7,499.0	3,733.6
Gross growth...	649.7	242.3
Mortality......	25.2	13.8
Net growth.....	624.5	228.5
Drain..........	468.5	144.1
Net increase...	156.0	84.4
Ending inventory...	7,655.0	3,818.0

Mortality, it is seen, amounts to only about 5 percent of gross growth, or one-third of 1 percent of beginning inventory (growing stock). Board-foot growing stock showed a net increase of 2.1 percent during the year; cubic-foot growing stock, 2.3 percent.

These are substantial percentages of increase. But they are scarcely high enough to promise a material improvement in timber density except over a very long period of years. Even to double board-foot growing stock, assuming that a constant percentage increase could be maintained (which is unlikely), would require 35 years.

Nevertheless, a rate of forest regeneration of this order is probably a sufficiently high goal for the district. It may even be too high. The district cannot be expected to undergo for long a very substantial decrease in the industrial flow of timber products, which form such an important part of its life blood. And on the other hand, the opportunities for increasing timber growth are greatly limited. Some reduction in non-essential drain may be effected through intelligent measures for correcting harmful cutting methods and for permitting the woods owner to practice some abstinence in the use of small timber. If such measures succeed in maintaining a rate of increase in growing stock of more than 2 percent, the result probably must be considered satisfactory.

It is misleading, however, to pursue the question of growth-drain balance too far upon an over-all, district-wide basis. Considerations of particular kinds of timber and of particular localities may outweigh the over-all considerations.

Within the over-all picture of growth surplus over drain, for example, are many items -- often key items -- of deficit. There is very little aggregate surplus in the Southern Piedmont -- 0.9 and 1.5 percent in board feet and cubic feet, respectively, as compared with 4.2 and 3.5 percent for the Northern Piedmont. In the entire Piedmont softwoods show a deficit of 29 million board feet, or about 1 percent of growing stock, and the deficit in the Southern Piedmont amounts to nearly 2 percent. For shortleaf pine alone the deficit there is 4 percent. Growth greatly exceeds drain in nonsawtimber stands, but the two are just balanced in saw-timber stands, and there only because a surplus in hardwoods makes up for a deficit in softwoods. As regards tree diameter, again, there is typically a surplus in small sizes, a deficit in large, with some irregularities due to pulpwood cutting in intermediate sizes, different standards of sawlog merchantability for softwoods and hardwoods, and other causes. Table 8 gives percentages

Table 8. -- Net percentage change in total cubic-foot growing stock in saw-timber stands in the Southern Piedmont, by tree species and diameter class, 1940[1]

Tree species	Diameter class (inches)				
	All classes	6-8	10-12	14-18	20 and larger
	Percent	Percent	Percent	Percent	Percent
Shortleaf, loblolly pines...	-3.9	-1.0	-5.2	-3.8	-17.1
Virginia pine, other sftwds.	-0.9	-0.8	-1.1	0.6	-7.8
Oaks........................	1.0	2.2	-0.5	2.2	0.6
Gums, yellowpoplar..........	1.5	3.3	0.9	0.6	2.3
Other hardwoods.............	3.6	4.7	1.6	4.1	5.8
All species.................	-0.4	0.8	-2.0	0.4	-0.1

[1] See also table 28.

of surplus or deficit in one group of stands where the problems in growth-drain balance are typical.

The Forest Survey data do not reveal what in some cases may be a more serious forest-depletion situation than any of those mentioned; a balance between growth and drain achieved in the face of high deficits in some localities, counterbalanced by substantial surpluses in others. The southeastern corner of the Piedmont and portions of several counties in the central section represent such deficit localities, whose problems fail to appear on the district level because of offsetting surpluses in the mountain and northwestern counties. Even in a region like Piedmont Virginia where some forest industries, particularly lumbering, enjoy a high degree of mobility, it is of no very great direct benefit to people in a community of dwindling forest resources, that there exist other communities where forests are being built up through an excess of growth over drain. And even within those favorably situated communities the individual farmer whose woodland is being overcut has a problem whose only real solution in most cases lies within that farm itself.

The statements just made, pointing out the seriousness of local timber shortages, do not imply an argument for economic self-sufficiency for its own sake. It is recognized, however, that in an area like Piedmont Virginia it is in many cases desirable for individual communities, and particularly for individual farms, to have their own supplies of timber. This results from a number of factors, chief among which are the primary suitability of much land for forest use, the advantages to be gained from organizing forest and mill employment as a supplementary occupation, and the low value, relative to weight, of the great majority of forest products handled in the district.

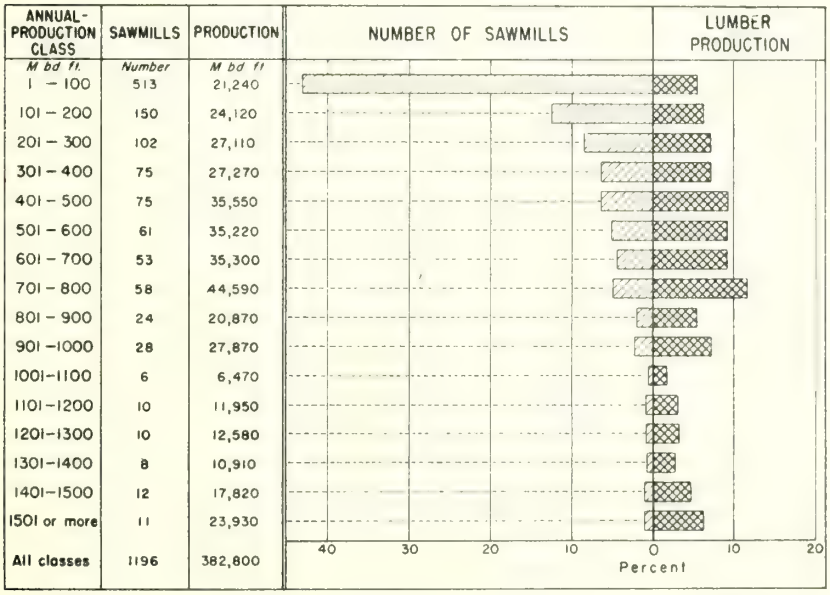
Lumber Industry

Today as in the past, small timber holdings, small-scale logging, small logs, small mills, and part-time operation and employment characterize Piedmont Virginia's lumber industry. Of the district's 1,196 sawmills, producing 383 million board feet of lumber in 1940, half produced less than 150,000 board feet during the year. One-fourth produced less than 40,000 feet. The distribution of sawmill numbers and production is shown graphically in figure 22.

The great bulk of the sawmills, and virtually all the smallest mills, are farm owned and operated. These mills, as pieces of farm equipment, stand in much the same category as the farm tractor or thrashing machine. During the off-season for farming the farmer and his hands set up their simple sawmilling equipment in the woods and turn out their year's requirements for rough lumber, with perhaps a surplus for cash sale in the market. Neighbors without mills of their own bring in logs for "custom sawing" in exchange for a fee or for a share of the lumber. But most farmers and other small sawmill owners engage in the lumber business on a commercial scale, buying stumpage and selling the lumber. Those without the means to finance such an operation may cut lumber on contract for some lumber yard or dealer, the latter buying the stumpage, assuming the marketing risks, and paying the mill owner a flat fee for his work. In general, only the larger mills buy delivered logs, though many of them also buy stumpage or use timber from their own land. The percentage of total sawmill production accounted for by each of these operating methods is as follows:

	Percent
Stumpage purchased	56
Contract sawing	24
Timber from own land	9
Logs purchased	6
Custom sawing	5
All methods	100

Mills engaged in operating purchased stumpage or in sawing on contract are, as a general rule, moved directly to the site of each logging operation. More than three-fourths of all mills are classed as portable mills. The typical portable mill is relocated three or four times in the course of a year, and the Piedmont sawmill industry thus presents a constantly shifting scene. Mill locations as determined at the time of the sawmill canvass in 1941 are shown in figure 23.



ANNUAL-PRODUCTION CLASS	SAWMILLS	PRODUCTION
M bd ft.	*Number*	*M bd ft*
1 – 100	513	21,240
101 – 200	150	24,120
201 – 300	102	27,110
301 – 400	75	27,270
401 – 500	75	35,550
501 – 600	61	35,220
601 – 700	53	35,300
701 – 800	58	44,590
801 – 900	24	20,870
901 – 1000	28	27,870
1001–1100	6	6,470
1101–1200	10	11,950
1201–1300	10	12,580
1301–1400	8	10,910
1401–1500	12	17,820
1501 or more	11	23,930
All classes	1196	382,800

Figure 22. -- Percentage distribution of sawmills and lumber production, by annual-production class of sawmills, 1940.

Under these conditions, log-hauling distances between woods and mill are usually short: less than 1 mile on the average. Logs are skidded by mule or horse, or (in the eastern counties) hauled on high wheels, direct to the mill. For the longer hauls, particularly those in excess of one-half mile, truck or wagon transportation is usual. Logging as it is carried out in the Piedmont, with transient operations gathering their timber from scattered woodlands, is made possible by the district's good network of roads: nearly 97 percent of the land lies within 1 mile of a road.

Piedmont-Virginia sawmills fall logically into four classes, based primarily on daily output capacity and differing markedly in equipment and organization (table 9). There is a marked increase in annual output, days of operation and number of employees with increasing mill size. Even more marked is the part-time character of operation of most mills. Equipment is simple and often crude. Most mills have only the bare essentials for sawing lumber: carriage, feed works, circular headsaw, and power source. Few mills of less than 6 thousand feet daily capacity have an edger. Edging, in these small mills, is done on the headsaw. Of the mills of less than 10 thousand feet daily capacity, 8 percent have a planer, 1/2 of one percent have a dry kiln.

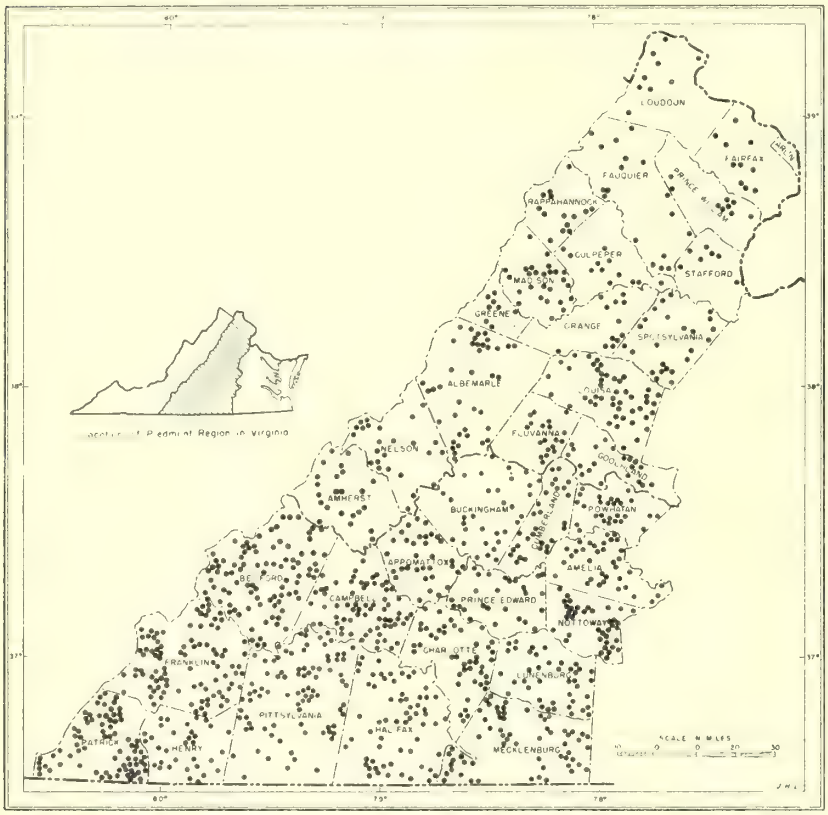


Figure 23. — Location of sawmills, 1941.

The large number and small size of units in the sawmill industry; their part-time character and position subordinate to other occupations; chiefly farming; and their deficiency in mechanical equipment would be expected to place the industry under the dominance of a few relatively large, efficient and financially stable concerns in the finishing and marketing field. This is, in fact, the case. Dominance over the lumber industry is exercised by the concentration yards, including furniture factories. These yards, of which there are about 40 in Piedmont Virginia, purchase the bulk of the district's scattered output of green, rough, ungraded lumber ---or contract for its production. They dry, plane, and grade the lumber and market it in quantity. They finance the operation of many mills and even, in some cases, provide book-keeping and similar services.

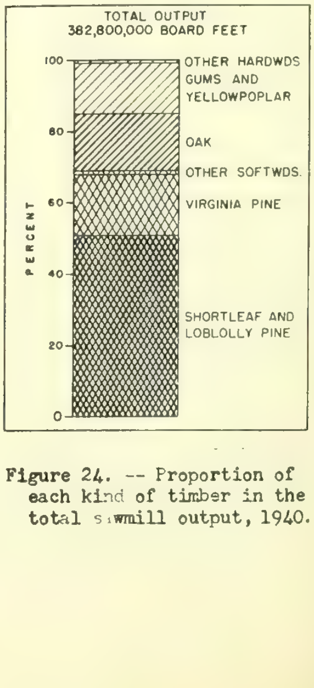


Figure 24. -- Proportion of each kind of timber in the total sawmill output, 1940.

Total production of lumber, timbers, and sawed ties by the district's sawmills amounted in 1940 to a little more than 380 million board feet, of which nearly 270 million (70 percent) was softwood (fig. 24). In the Southern Piedmont, whose mills turned out more than three-fourths of the total quantity of these products, about 55 percent of the output was shortleaf pine alone. Table 29 contains the production figures for the sawmill and other primary wood-using industries.

Table 9. -- Descriptive summary of sawmills, by daily output-capacity class, 1940

Descriptive item	Daily output-capacity class (M bd.ft.)				
	All classes	1-2	3-5	6-9	10 +
Numbers and output:					
Number of mills	1,196	303	687	195	11
Percent of all mills	100	25	58	16	1
Percent of total output	100	3	51	41	5
Annual output per mill, M bd. ft.	320	42	287	798	1,620
Operation and employment:					
Average operating days per year	81	26	86	145	146
Percent custom mills[1]	25	52	20	1	0
Average number of employees	4.3	2.7	4.3	6.2	12.1
Power and equipment:					
Typical horse power (steam equivalent)	....	18-	20	25	25+
Type of power source:					
Steam (percent)	44	45	45	37	82
Power units (percent)	30	8	33	57	18
Car motors (percent)	15	27	13	1	0
Tractors (percent)	9	15	9	1	0
Water (percent)	1	5	0	0	0
Electricity (percent)	1	0	0	4	0
All types (percent)	100	100	100	100	100
Percent having edgers	13	2	6	47	91
Usual type of feed	....	Friction	Friction or belt	Belt	Belt or steam

[1]/Mills one-third or more of whose output is custom lumber.

Concentration in the southeastern Piedmont of shortleaf and loblolly pines, the favored lumber trees, and the better conditions of stocking and site in the southeast make for a concentration of lumbering in that part of the district. Figure 25 suggests that lumber production per acre of forest land is greatest near the southeast corner of the district and declines rather regularly toward the north and west. The small size of mills and the fact that they draw so largely upon nearby supplies of timber make it possible to regard figure 25 as essentially a map of the magnitude of lumber drain upon the forest.

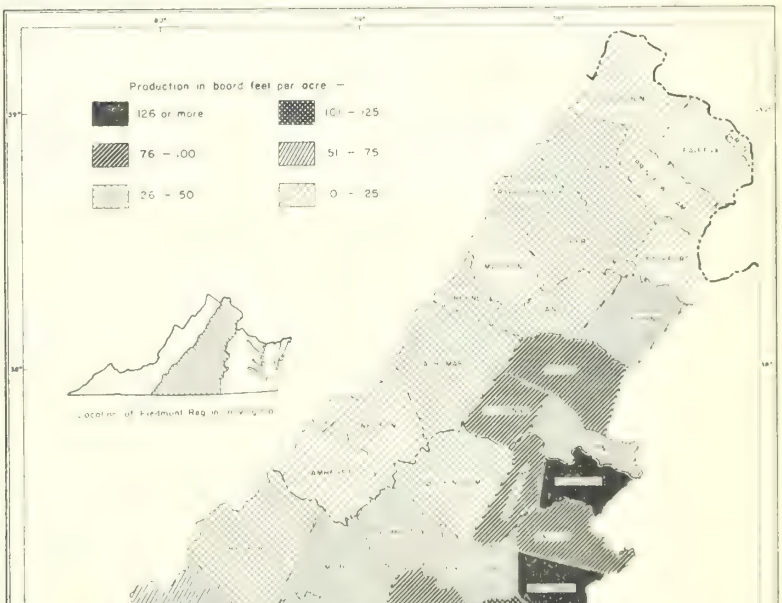

Production in board feet per acre —
126 or more
101 – 125
76 – 100
51 – 75
26 – 50
0 – 25
Location of Piedmont Region in Virginia

Figure 25. — Lumber production per acre of land other than cleared land in farms, by county, 1940 (12).

The Pulp Industry

The pulp mills of the Piedmont are located near its western border (fig. 26). There are two mills, one producing paper board (and tannic acid) from chestnut, the other producing corrugating paper from pine. But the pulp industry extends, in its woods operations, nearly throughout the Piedmont. Pulpwood, indeed, is a major forest product and source of woods employment. In 1940 the harvest, including chestnut, amounted to about 270,000 cords, the great bulk of which was shipped by railroad over distances as great as 200 miles, to mills located in the Coastal Plain and mountain districts of Virginia (fig. 26) and in other States. Three-fourths of this wood was pine. The Piedmont pulpwood industry is favored by a good system of railroad transportation, with virtually no area in the district situated beyond 15 miles from a railroad.

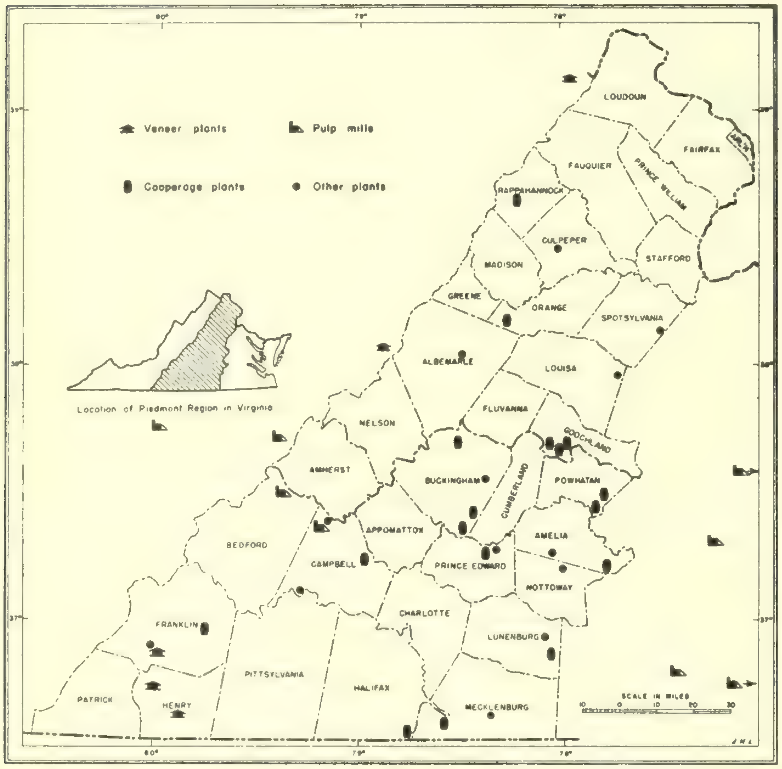


Figure 26. -- Location of primary wood-using plants other than sawmills, 1941. (Some of the outside plants important as markets for Piedmont timber are shown.)

Areas of concentration of pulpwood operations are indicated in figure 27.

Veneer Industry

Like the plants of the Piedmont pulp industry, those of the veneer industry are all located near the district's western border. But unlike the pulp industry, woods operations, also, are confined to the west. The district supports three mills manufacturing rotary veneer and plywood. Two additional mills just across the western boundary draw a substantial share of their supplies from the district (fig. 26).

Piedmont veneer mills consumed in 1940 some 8-1/2 million board feet of logs. These logs were purchased delivered at the mill. Three-fourths of the timber was yellowpoplar; most of the remainder, sycamore and black tupelo.

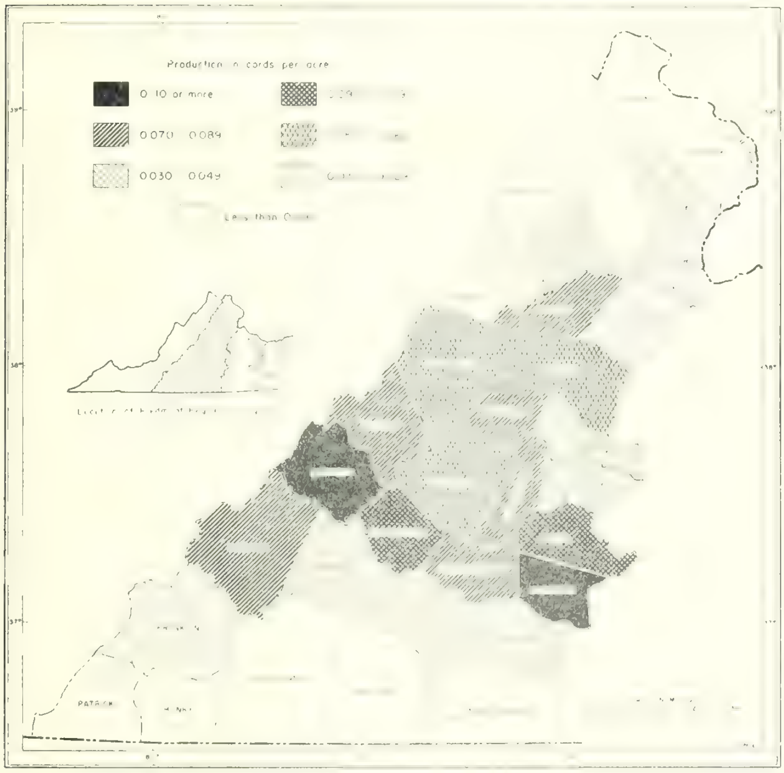


Figure 27. -- Estimated pulpwood production per acre of land other than cleared land in farms, by county, 1940 (12).

Cooperage Industry

There are 17 plants in Piedmont Virginia manufacturing barrel staves or headings. The numbers of cooperage plants which produce each of the principal types of product are as follows:

	Number
Nail kegs	5
Potato barrels	4
Tobacco hogsheads	2
Other slack cooperage	5
Tight cooperage	1
All types	17

Employment in these plants ranges from 4 to 18 men, with an average of 9. Shortleaf pine is the principal wood used; together with loblolly pine, it comprised nearly nine-tenths of the 18,000 cords of total plant consumption in 1940. Virginia pine, yellowpoplar, and white oak, in about equal amounts, made up the balance. Most of the timber was purchased as stumpage from farmers.

Other Primary Forest Industries

Within the district are 13 other wood-using plants which take logs or bolts direct from the woods as their raw material. Following are the types of plants, the number of each, and the chief woods used:

Excelsior (1): pine.
Handles (5): hickory, oak.
Wood turnings (1): pine.
Insulator pins (2): black locust, oak.
Dimension stock (1): oak, sycamore, walnut.
Cedar chests (1): cedar.
Picker sticks (1): hickory.
Wooden utensils (1): sweetgum.

The 1940 wood consumption of these plants, other than the cedar-chest factory, was 6,200 cords.

Fuel wood and piece products comprise the balance of timber production. Of these, fuel wood assumes chief importance in point of quantity, its annual production amounting to 1-2/3 million cords. In fact, fuel wood comprises more than half of the total quantity of wood, in cubic measure, produced or consumed by primary forest industries in Piedmont Virginia -- the lumber industry included. Forty-three percent of the wood used is oak; 37 percent, pine. It is estimated that more than two-thirds of the fuel wood is taken from dead and cull trees, tops and limbs of sound trees, mill waste, and other sub-standard material -- representing, on the whole, an efficient utilization of this material. Only about 8 percent comes from sawlog portions of sawlog-size trees. This represents, likewise, only about 8 percent of the total harvest of sawlog material.

Secondary Wood-Using Industries

Within Piedmont Virginia are some 125 plants using lumber or other partly finished wood products as a major raw material in manufacture (7). The numbers of these plants by type are as follows:

	Number
Planing and millwork.....	70
Furniture................	24
Yarding and treating.....	10
Containers...............	6
All others...............	15
All plants...........	125

The planing and millwork establishments are spotted rather generally throughout the district, with some concentration in the large towns, and in the southeastern counties where lumber production is greatest. Many of the plants serve as concentration yards. Their relation to the sawmill industry has been noted. However, less than half of all the lumber they use is produced within the district.

Two thirds of the furniture factories in Virginia are located in the Piedmont. Here they are largely confined to the southwestern counties, centering upon Martinsville and Bassett, in Henry County, and Rocky Mount, in Franklin County.

Employment and Income

Cutting, preparing, hauling, and processing timber products affords annually almost 5-3/4 million man-days of employment. The total number of individuals engaged in these activities amounts to some 35,000 -- more than one-fifth of the entire personnel in agriculture, industry, and business in Piedmont Virginia. Table 10 shows the numbers of men and man-days of work in the various types of employment. The number of workers producing fuel wood and fence posts for home use has not been shown, since it would include nearly every farmer in the district and would not be comparable with other items in the table. Because some individual workers engage in both woods and mill work and others are employed in several different primary industries, the total number of men in these industries, as shown in the table, is less than the sum of constituent items. This avoids double counting.

Table 10. -- Employment in forest industries, 1940

Industry	Total employment		Woods employment		Mill employment	
	Men	Man-days	Men	Man-days	Men	Man-days
Primary industries:						
Lumber	9,160	1,004,600	5,000	459,600	5,660	545,000
Veneer	250	58,600	80	17,900	170	40,700
Cooperage	240	32,800	80	11,200	160	21,600
Hewn ties	360	36,200	[1] 360	36,200	......	....
Pulp	3,600	292,000	[1] 3,600	292,000	(See "others")	
Fuel wood for sale	14,370	503,200	[1] 14,370	503,200	......	....
Fence posts for sale	2,040	7,100	[1] 2,040	7,100	......	....
Poles and piles	50	8,800	[1] 50	8,800	......	....
Others	1,400	374,400	130	12,000	1,270	362,400
Total	29,720	2,317,700	23,960	1,348,000	7,260	969,700
Fuel and posts for home or farm use	......	2,073,300	....	2,073,300	......	....
Secondary industries	5,360	1,340,300	....	....	5,360	1,340,300
All industries	35,080	5,731,300	23,960	3,421,300	12,620	2,310,000

[1] Computed from the man-day figures on the basis of estimates of the average period of employment per man.

Table 10 reveals several striking facts. One of these is the overwhelming position of fuel wood in the forest-employment scheme. Of all industrial woods employment in Piedmont Virginia (including primary transportation), nearly three-fourths arises in fuel-wood production. Even if the entire forest-industrial employment is considered -- in mills as well as in the woods, and in secondary as well as primary industries -- fuel wood still accounts for about 45 percent of the total. Another fact is the typically part-time character of forest-industrial employment, particularly woods employment. Woods laborers other than those who make fuel or posts for home use put in only about 55 days, a little more than 2 months, during the year. For most of these people, and for many of those in the plants as well, this work is a side line to farming.

Employment in the woods, and plant employment on timber products produced within the district, together with stumpage returns and other income arising directly from the district's forests, accounted for about 10 percent of all the income received by the people in 1940.

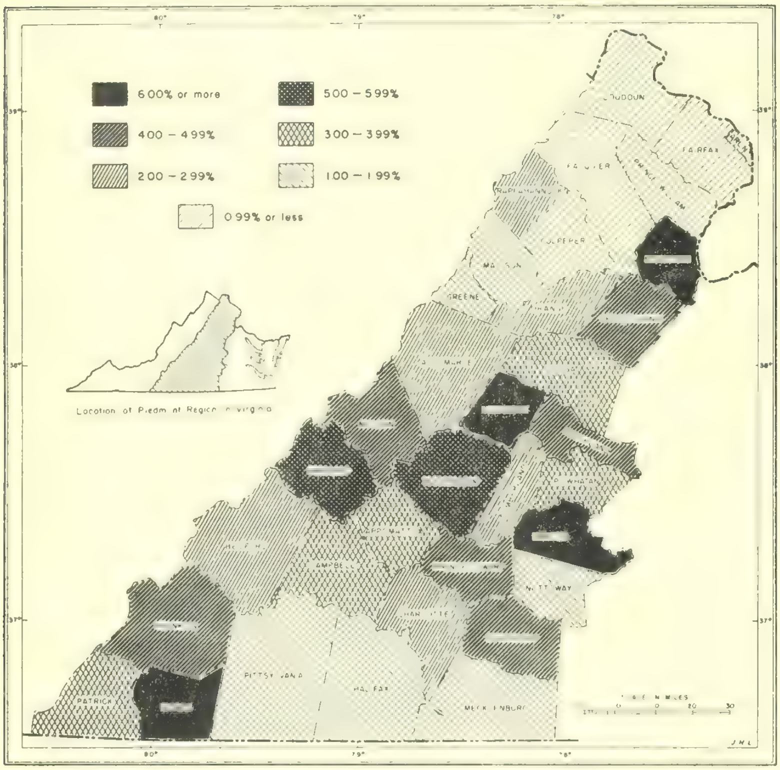


Figure 28. -- Value of farm-forest products sold, in percent of the value of all farm products sold in each county, 1939 (12).

Sale of timber furnished about 2 percent of farmers' gross cash income from the sale of farm products in 1939 (12). This proportion ranges from a negligible figure to nearly 8 percent in individual counties, running especially high in the central and southwestern counties (fig. 28). Not included in these income figures is the value of products used on the farm or the wages received from off-farm employment, of which a substantial part was forest employment.

The depletion of forests and the strong limitations placed upon them in contributing to the income of Piedmont Virginia arise largely from three major forestry problems -- overcutting, inefficient timber marketing and utilization, and fire.

Overcutting Problem

One of the chief forest problems in Piedmont Virginia is the destructive cutting so prevalent throughout the district. This forest exploitation is favored by many circumstances. The complete network of roads gives to nearly every patch of woods a high degree of physical accessibility. Frequent railroad lines furnish direct connections with the pulp mills of the State. These mills, together with the other wood-using plants, and particularly the itinerant sawmills, provide markets for most of the types of timber -- even of the smallest sizes -- growing in the district; and a heavy demand for fuel wood helps to fill the gaps left by processing industries.

Working in conjunction with physical accessibility and marketing opportunities are the ability and the necessity for labor and industry in Piedmont Virginia to draw heavily on forest resources. The poverty of the soil over great sections of the district throws a large population upon the forests as a major source of livelihood. When work is scarce and the prospect of farm income limited, the owner and laborers in a small sawmill can afford to conduct operations in timber which will meet only the very lowest production standards, particularly when stumpage prices are themselves low. Logging and pulpwood cutting as a source of part-time employment thus can be carried on in timber which is extraordinarily sparse, small sized, and poor in quality.

The timber owner, in his turn, can scarcely escape the circumstances which force forest liquidation. Chronically in pressing need of cash income, he takes out, at frequent intervals, whatever trees can be found that will yield a little wood for sale -- pulpwood, a tie, or a substandard sawlog -- products of low grade and value. In this way he keeps the forest trimmed down close to the lowest limit of merchantability. His need for timber income leads to the perpetuation of that type of timber stand from which the income is lowest.

Entering the market as an anxious seller, with mostly low-grade products to offer, the timber owner helps to maintain low stumpage prices. Buyers, on their part, typically make their offers "by the boundary," on a lump-sum basis, setting their estimates low so as to allow for the wide error to which these estimates are often subject. Resulting poor returns from his woods lead the timber owner to place a low value upon his woodland and so to neglect whatever care might be given it to improve its productivity. The poverty of the forest and that of its owners represent in effect two segments of a vicious circle.

Meanwhile, forest depletion is furthered by the destructive cutting methods attendant upon lump-sum contracts, by the average timber owner's reluctance to engage personally in the logging operations, and by widespread indifference to the potentialities of the forest.

It is not easy for any individual to overcome this situation, long established in custom. The Virginia Forest Service, for example, in attempting sales of selected and marked timber from the State Forests, has found difficulty in obtaining bids, the buyers having access to ample timber nearby which can be bought and cut without restriction. Individual timber operators, again, feel that they cannot afford to follow advanced cutting practices when other operators are not doing so and when the chief lumber market is for run-of-the-mill grades.

Under the pressure of these circumstances, only a small proportion of woodland owners make a conscious effort to manage their woods for a continuous yield of products. Over the district as a whole the proportion is about 5 percent.

During recent years the public has given increasing thought to this question of forest depletion through bad cutting practices. The sentiment is growing that just as there is a measure of public concern in forest rehabilitation, so there must be a measure of public control over forest management. In one county in the central part of the district, for example, where woodlands have been badly abused and their contribution to local living seriously impaired, a citizens' committee was formed in the winter of 1941-42 to study the forest situation. Farmers and professional and business people, including representatives of the lumber industry, formed the committee. The only basic solution to the problem of private mismanagement of forests, they have concluded, is public legislation to control cutting practices. The case of this committee is not an isolated one. Indeed, it is being increasingly recognized, especially in those localities where the pinch of forest exhaustion is beginning to hurt, that only through public regulation can a determined minority be prevented from endangering the interests of the people at large.

In support of a program of public regulation, several supplementary measures appear to be needed. One is public education, aimed at acquainting people with the facts of the forest situation. Another is public assistance in extending credit to small woodland owners, permitting them to let their timber grow so that eventually it can produce regular yields in full measure, commensurate with the district's needs for forest income and employment. Still another is education, service, and assistance -- both public and private -- to timber owners, to acquaint them with approved forest-management methods and to demonstrate the results which may be expected from practicing them.

Marketing Problem

On a par with overcutting as a major forest problem in Piedmont Virginia is the problem of timber marketing and utilization. It is the problem of low returns to the timber owner from the cord of wood and the thousand board feet of logs that he sells, and the low returns to the labor -- and in many cases the business enterprise -- engaged in cutting and milling those products.

Most farmers and other woodland owners have little or no idea of the quantity and quality of standing timber in their woods. When they make sales on the customary lump-sum basis they are at the mercy of the buyer, who, himself, often can estimate timber volumes only in the roughest sort of way. To provide a margin of safety, estimates are usually placed very low. One mill man in Halifax County, purchasing timber by the thousand board feet log scale, estimated that he would get between 15,000 and 20,000 feet from one tract. When the operation was completed he had cut 75,000 feet. A woods owner in Buckingham County, offered a lump sum of $35 for his timber, decided instead to sell it to another buyer by the thousand board feet. The tract yielded about 125,000 board feet of logs and returned the owner between $600 and $700.

Apparently there is great need for a staff of technical consultants, working under the direction of the State Forester and Extension Forester, helping timber owners to appraise and mark their timber for sale and advising them on marketing. Such work might well be financed by fees charged per thousand board feet or cord of timber marked. The demand for this service would probably justify placing one consultant in each small group of counties. Furthermore, there is now believed to be opportunity for private consulting foresters to engage in this type of work in small groups of counties in the principal timber-producing sections.

Even if sold by the unit of measure, however, timber customarily yields but poor returns. Except in the southern tobacco counties, where owners often do their own logging, owners customarily make sales on the stump, forfeiting the labor income they might otherwise receive. Again, the principal outlet for saw timber is the small, inefficient portable sawmill operating under the domination of the concentration yard -- turning out a low-quality, mostly ungraded product and consequently able to pay only a low price for raw material. The outlet for pulpwood in any locality is in most cases only one or two pulp mills, which are thus largely free to dictate the terms of the market. Pulp companies purchase their wood through contractors, to whom shipping points are assigned. These contractors buy the wood direct from farmers and other timber owners -- or they may get their wood through subcontractors, who in turn purchase it from owners or further intermediaries. Two layers of pulpwood contractors are common; and in at least one locality, in one of the central-Piedmont counties, four distinct layers may be recognized, each taking a cut from the mill price, with consequent reduction in the price paid the timber grower.

It is not the timber owner alone who suffers from the marketing situation. In the field of lumber, the timber buyer, logger, and sawmill man are scarcely better off than the owner, for although they get their raw materials cheaply, the low quality of these materials and the inefficiencies in sawmilling and subsequent marketing provide little room for profit. Generally speaking, it is the whole community which suffers from the problem of timber marketing and utilization, just as the whole community suffers from the mismanagement of the standing timber.

The individual can do little to improve these conditions. But on the other hand the cooperative form of marketing organization, which in some cases has surmounted individuals' handicaps, here seems to offer little promise. The people of Piedmont Virginia have had slight experience in cooperative organization, and none at all in the field of forestry. The few attempts made to organize forest cooperatives have been discouraged at an early stage. The fundamental factor in the present marketing situation -- control of outlets by a very few ultimate buyers --would remain unless a cooperative could itself operate a processing plant of considerable size and diversity. To do this efficiently would require a greater area of fully productive forest than now exists in the district. Thus in most of its phases the marketing and utilization problem is resolved into the problem of forest depletion, and its final solution must await a successful attack upon the latter problem.

Meanwhile there are several steps which can be taken. In one county in the southern tobacco section the Agricultural Agent has until recently been designated by the pulp mill to act as intermediary between some of the farm-woods owners and the mill, arranging for pulpwood shipments and allowing the farmer an equitable price for his product. In this and other ways the pulp companies can help to relieve timber owners of the burden of multiple contracting. In the sawmilling field, education can undoubtedly make some improvement in cutting and grading practices, and technical efficiency can be greatly increased through the introduction of improved types of small mills.

Even under present conditions, however, the forest owner can get a reasonably fair return by careful management of the cutting operation and by seeking the best available outlets for his wood. One farmer in Louisa County, who owns about 100 acres of shortleaf pine with a stand of some 16 cords per acre, is managing his tract on a sustained annual-yield basis, cutting the trees in groups for pulpwood, sawlogs, and poles. His yearly harvest amounts to about 50 cords, or one-half cord per acre, roughly equivalent to net growth. After payment of cutters' wages and transportation costs his net annual receipts have averaged $225, or $2.25 per acre. From most of the cordwood and saw-timber pine stands of the district, a yearly stumpage return of $2.00 or more per acre may probably be realized at present if the owner has his timber carefully marked and cut and finds the best available markets

Two dollars of net annual return per acre would mean, for the typical farmer owning a 55-acre woodland, about $70 of cash income every year from the sale of wood not needed on the farm. In the light of low farm incomes in the district, this is a substantial sum of money. In 1939, 27 percent of all farm families received a total gross farm income of less than $250, including the value of all products used on the farm, traded, or sold. In the same year, 45 percent of all families received less than $400; 62 percent received less than $600 (12).

Only a small part of the returns of low-income farmers is in the form of cash: most of their income is in the form of subsistence -- products produced and used by the household. Subsistence farms, where such products formed the major part of income, comprised 57 percent of all farms in 1939 (12). It follows that a possible net return of $70 cash from the woods may be a critical item of income for many woods owners -- the means to discharge pressing cash obligations like taxes, doctor bills, and installments on debt.

It is not the objective of any forestry program to prolong the existence of maladjustment in farm population -- to offer any encouragement to farmers to remain on overcrowded, infertile crop lands in the face of a crying need for out-migration, fewer and larger farms, and land retirement. One of the main objectives of a forestry program, however, is to increase the income from forest land so that as many as possible of the existing population may remain to enjoy a reasonable level of living from the pursuits available to them, farming and forestry included. Part of such an increase in income must be obtained through increased efficiency in timber production, processing, and marketing. But part should come, also, through production of greater quantity and quality of timber products.

This brings to the fore another type of marketing problem: In order for increased timber output to raise income, there must be a demand for this timber; volume and quality production alone do not guarantee high returns. It is the long-run problem of translating production into income.

How successfully the district meets this problem will depend upon its participation in the expected national expansion of such fields as residential housing, pulpwood production, and the use of veneer and plywood. Also it may depend upon increased exports of timber from the district; and, again, upon development of industry to meet new needs of the localities themselves.

Fire Problem

The third general forest problem in Piedmont Virginia is that of fire. Forest fires of the past are responsible for much present woods depletion and cull timber. Although in recent years fires have been greatly reduced in extent, they still cause considerable damage, particularly in isolated years when weather conditions are unfavorable. During the 5-year period 1937-41, in the 32 Piedmont counties which belong to the State protection system, an average of about 18,000 acres, or two-fifths of one percent of the protected forest area, was burned over annually. In a number of counties fires burned between one-half and one percent of the protected forest land (fig. 29). Of the typical year's 840 fires, nearly 40 percent started from brush, pasture, and field burning, mostly in the spring; about 35 percent were started by careless smokers, mostly fall hunters; railroads and incendiaries each accounted for less than 10 percent of the number (17).

The extent of fires in recent years has been remarkably small, considering the meager allotments available to the Virginia Forest Service for fire protection. Combined contributions of Federal, State, and county governments and of the few private land owners who pay into the fire fund have amounted to little more than one cent per acre of land protected.

Perhaps the most pressing need is for funds to allow the three unprotected counties of Piedmont Virginia to be brought into the protection system. An increased appropriation is needed, also, to intensify the now badly overextended system in protected counties -- to permit reducing the size and increasing the number and effectiveness of administrative districts. The Piedmont is now comprised largely of two such districts, with gross acreages of 4 and 6 million acres; whereas an idal administrative district should not greatly exceed 1 million acres.

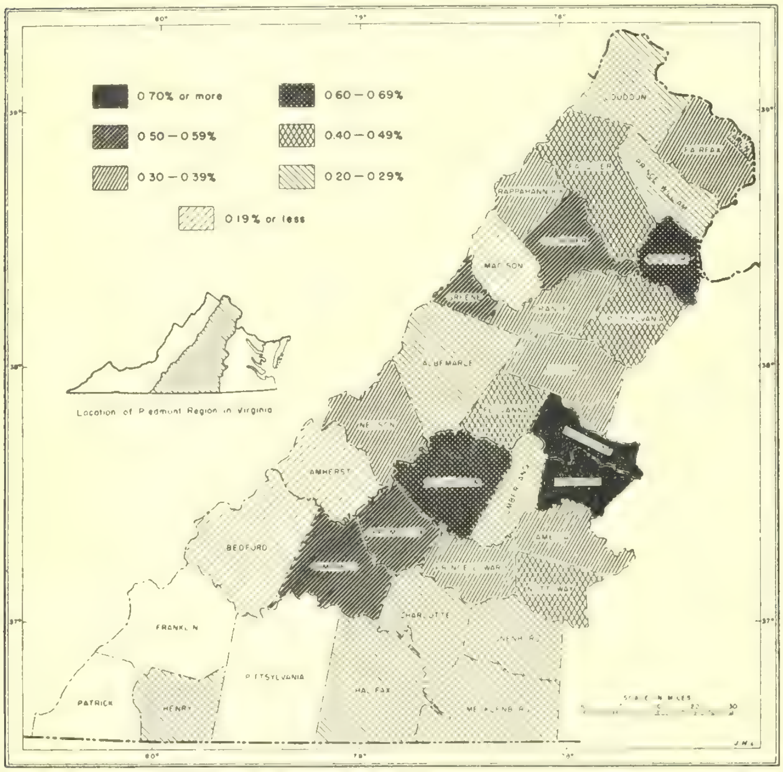


Figure 29. -- Proportion of protected forest land in each county burned annually, 1937-41 (17). (Blank counties not in the State protection system.)

Much needs to be done, also, in educating people on the destructiveness of fire and the necessary precautions to prevent it. A large share of this job falls in the realm of agricultural extension. State leaders in the field of agronomy, especially, should lend their wholehearted support to discouraging the common practice of broomsedge and crop-residue burning, now responsible for such a large share of the forest fires.

Forestry Sections and Their Problems

Piedmont Virginia may be subdivided into a number of sections, each more or less distinct with respect to land and forest conditions and the relationships of forestry to general economic activity (see fig. 30). While most of these sections have the major forest problems of fire, destructive cutting, and inefficient utilization and marketing, each of them has additional problems peculiar to itself A description of the forestry situation in these sections is helpful to an understanding of the needs of forestry in the Piedmont as a whole.

Mountain Hardwoods Section

The Mountain Hardwoods Section of the Piedmont, comprising some 880,000 acres of land, includes the narrow strip of rugged, heavily wooded Blue Ridge Mountains along the western border. Here are some of the most productive hardwood sites in the Blue Ridge: the coves and eastern slopes. But fire, destructive cutting, and the inroads of chestnut blight have reduced most timber stands to a condition requiring many decades of management to remedy.

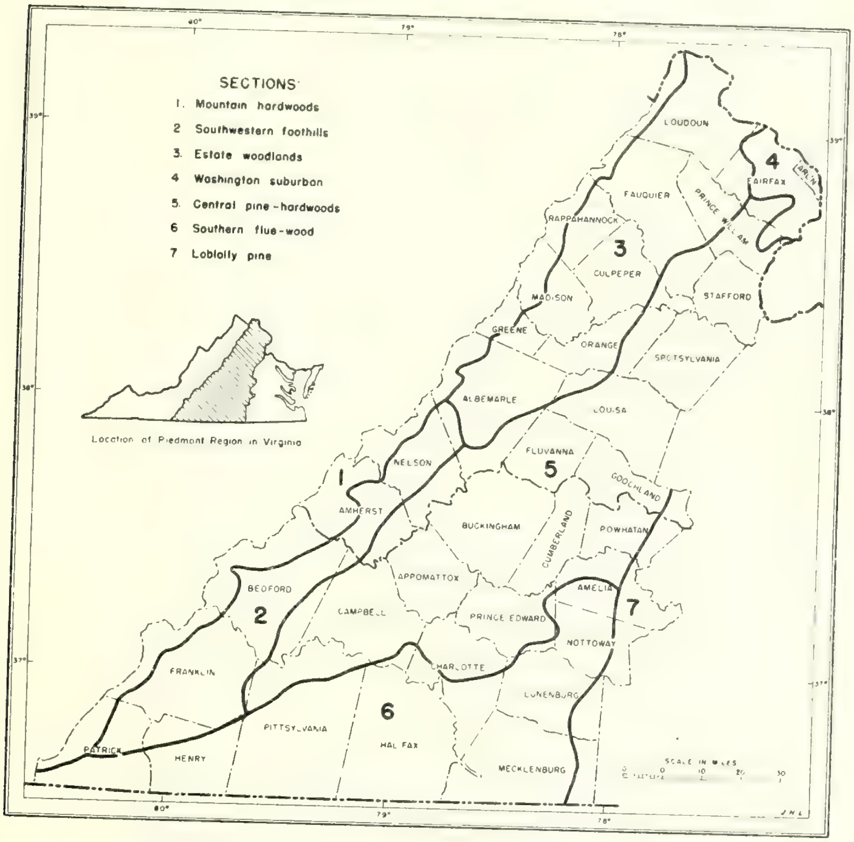


Figure 30. -- Forestry sections of Piedmont Virginia.

On the other hand, the people of the section have pressing need for the income which managed forests can offer. Lands are typically steep and poorly suited to agriculture, and while there is some successful fruit farming in the foothill coves, a bare subsistence farming is the general rule. Considering the limited potentialities of other resources, it is evident that the forest resource holds chief promise of providing badly needed cash income and better living.

Excellent markets at nearby Lynchburg, Martinsville, Rocky Mount, Waynesboro, Front Royal, and other centers offer outlets for a wide variety of forest products -- pulpwood, veneer logs, chestnut extract wood, sawlogs, cooperage bolts, and ties. But depleted growing stock and a poor system of secondary roads cancel much of the advantage which would otherwise stem from these good markets.

A public-works program of resource rehabilitation is one answer -- first, to create eventually a productive forest serviced by an adequate system of roads; second, to provide employment during the intervening period of waiting; third, to enhance the watershed and recreational values of the forest, important in this section; fourth, to provide for the local workers a practical education in the care and conservation of their forests. This program should be attended by considerable enlargement of public land holdings managed for timber production to promote the welfare of local communities.

The logical time for inaugurating such a program is at the close of the war, when many of the people who have migrated to industrial centers may return, to aggravate the pressure of population upon resources.

Southwestern Foothills Section

The Southwestern Foothills Section of the Piedmont, an area of 970,000 acres, is typified by scattered farm woodlands, with a few more extensive forest tracts (fig. 31).[5]

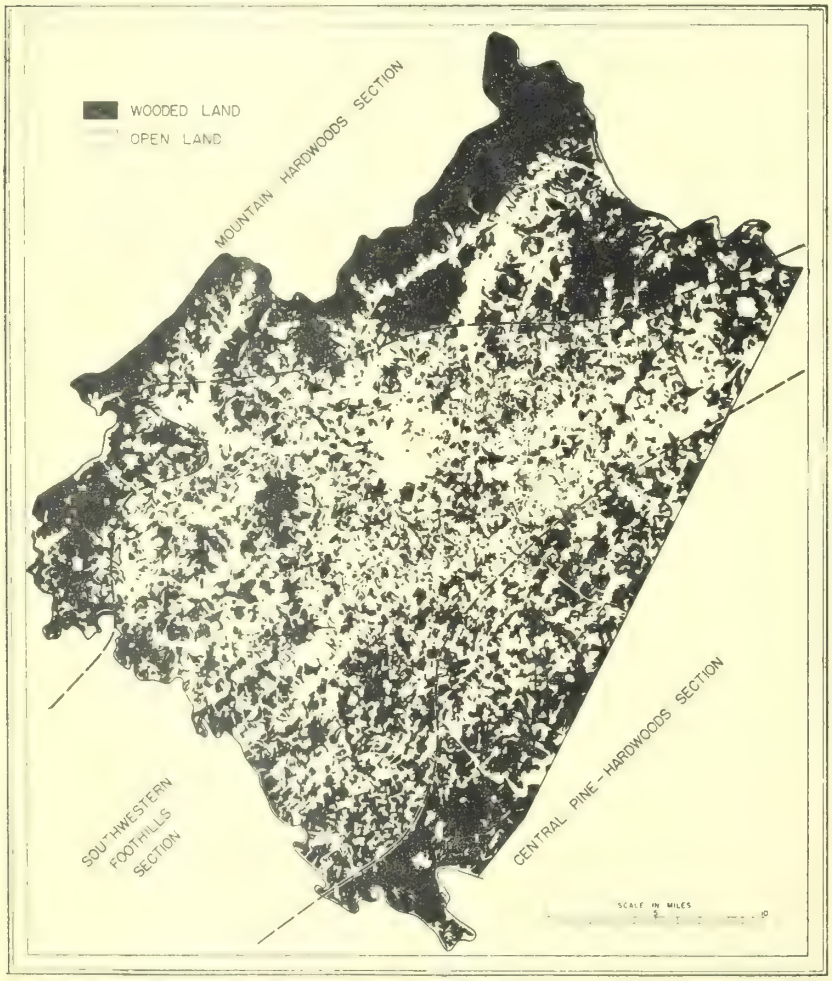

WOODED LAND
OPEN LAND
MOUNTAIN HARDWOODS SECTION
CENTRAL PINE-HARDWOODS SECTION
SOUTHWESTERN FOOTHILLS SECTION
SCALE IN MILES
5
10

Figure 31. -- Location of wooded lands in Bedford County, Virginia.

Most of the land is poorly suited to farming, and woods and sawmill work is a vital source of cash income to the subsistence farmers of the section. Many of the rural workers, however, turn to employment in the industrial centers -- Lynchburg, Bedford, Rocky Mount, Bassetts, and Martinsville -- as a major source of income, conducting their farming or timber operations as a side-line on a part-time basis. Expanding industries, including several wood-using industries, permit a fairly satisfactory level of living to a rather dense population.

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[5] Figures 31, 32, and 33 are based upon maps made under direction of the Virginia State Committee on Agricultural Programs, as part of the project in county agricultural planning.

The productivity of woodlands has been greatly reduced by fires, which have probably caused greater damage in this section than anywhere in Virginia east of the Blue Ridge. Well over a third of the section lies within counties not belonging to the State fire-protection system. The fire situation will be greatly improved when these counties are brought into the system.

Another destructive element threatening forest support to industrial expansion is the multitude of small sawmills that for years have been overcutting the timber. The need is particularly great in this section for introducing more efficient methods and equipment among small-mill operators.

In the northern part, where hardwood timber predominates and many of the farms raise cattle for milk and beef, damage to the woods through grazing is serious. In the southern part, the forests run heavily to pine -- mostly old-field Virginia pine. Introduction and encouragement of shortleaf pine through planting and stand management would greatly increase forest productivity.

Soil washing and gullying have severely damaged the heavily rolling erodible lands of the section. While the steepest hillsides have now been retired to forest, erosion is still active or threatening on all but the small acreage of fairly level crop land.

Estate Woodlands Section

The Estate Woodlands Section is an area of rather good agricultural soils and large farms, and, on the whole, of progressive land management. Its 1,750,000 acres are largely in pasture and crops, with hardwood and hardwood-pine woodlands dotted here and there among the farms.

Dairying, beef-cattle production, and fruit growing are the chief types of commercial agriculture. Besides the commercial farms, a great and increasing share of the land is in large estates, operated mostly as stock farms by persons whose source of livelihood is in Washington, Baltimore, and other urban centers to the east and north. The prevalence of stock raising and the use of woodlands for pasture result in much serious damage to the stands of hardwood timber. The disconnected character of woodlands, on the other hand, minimizes the danger of widespread fires.

On the estates, the chief motives in land management are aesthetic rather than monetary. Timber stands are managed so as to enhance their appearance, with production of material forest products a secondary consideration. On commercial farms, because of the restricted size of woodlands, the principal value of the timber is in furnishing materials for use on the farms themselves: fuel wood, fence posts, and repair lumber.

Washington Suburban Section

In the Washington Suburban Section, comprising some 210,000 acres, the use of land for residential purposes and for urban business takes precedence over other uses. Woods are relatively unimportant as a source of income.

Central Pine-Hardwoods Section

The central Pine-Hardwoods Section is characterized by the poverty of its soil, its forests, and its people. Its 3,440,000 acres (more than one third of all land in Piedmont Virginia) contain a large proportion of woodland. This woodland represents the regional extreme of poor stocking and of small size and inferior quality of timber.

Particularly in the north, the line of division between the Central Pine-Hardwoods Section and that to the west is remarkably distinct. East of this line are the poor Tatum and Nason soils, supporting a predominantly pine forest, with short-boled hardwoods in mixture, and permitting only a meager development of farming. West of this line the superior Davidson soils predominate, with a larger proportion of open farm land (fig. 32) and distinctly taller hardwood timber.

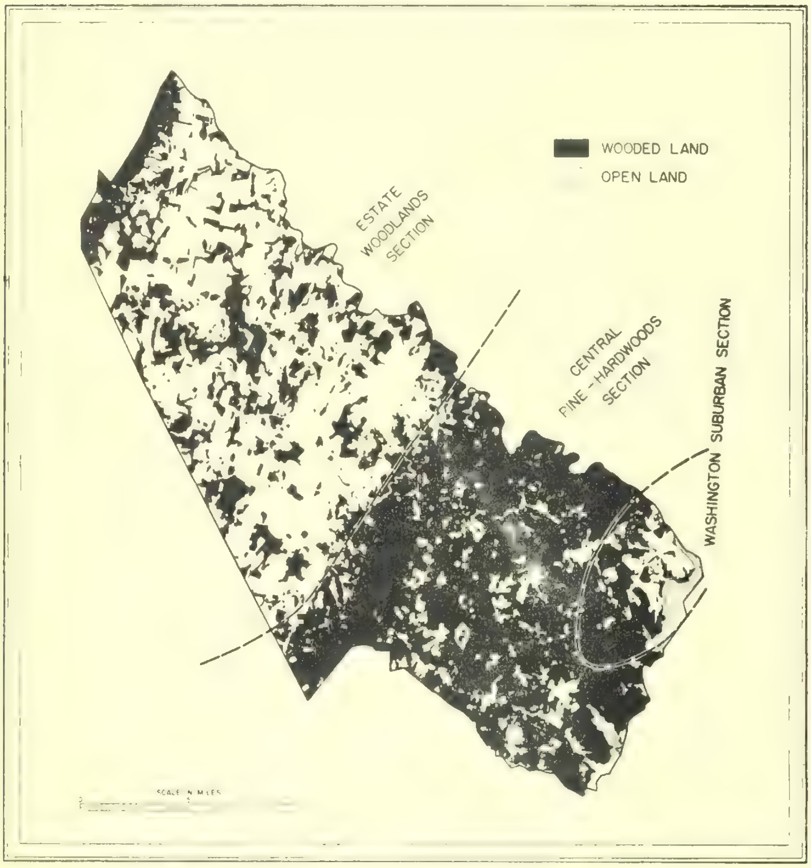

Figure 32. — Location of wooded lands in Prince William County, Virginia.

It is in this section that the problem of hardwood invasion of pine stands assumes its most serious form. In an economy constructed around the utilization of softwoods, the stabilization of agriculture and the heavy cutting of pine for pulpwood and sawlogs are rapidly increasing the proportion of hardwoods, which are much less productive than pine on these infertile soils and which find their chief use as fuel wood.

In fact, it is to be feared that the section may attain the quantity of hardwoods of the western sections, but without their favorable growing conditions and markets. At the same time, the Central Section is comparable to the Estate Woodlands Section in farm population, but lacks the latter's agricultural soils. And it resembles the Southwestern

Foothills Section in its depleted forests, but has no similar industrial development to serve as an outlet for surplus labor. The Central Pine-Hardwoods Section has most of the forestry problems, and few of the saving graces, of the remainder of Piedmont Virginia.

Despite over-cutting, burning, and other forms of abuse, the forest resource remains the heart of the economic life of the people, and the continuing abandonment of farm land throughout the section promises to increase the relative importance of forestry. In several counties, well over a fourth of all income received by the people arises in harvesting, transporting, and manufacturing forest products. In one county, the value of forest products is more than twice the value of all farm crops and livestock products. The level of this income, however, is too low to provide a satisfactory living. Beyond the reasonable possibilities of farm-population adjustment, that level can be raised materially only by increasing the contribution of forests and forest industries.

The Central Pine-Hardwoods Section illustrates more forcibly than any other section of Piedmont Virginia the need for legislative control of the use of forest resources. There appears to be little hope of arresting exploitation and building up productivity on private lands by other means. Such legislation should be preceded and supported by an intensive program of education.

The Virginia Forest Service administers some 40,000 acres of land in the section (virtually all the State Forest lands), and has designated an additional 380,000 acres as suitable for purchase. This land should be acquired both to build a backbone of productive forest within the section and to place permanently beyond the reach of agriculture those poorest lands upon which farming inevitably fails. The latter policy could be strengthened by a supplementary program of land-use classification and zoning.

Some forest land has been so denuded by cutting and burning that replanting of trees is believed by many to be the only efficient way to rehabilitate it. The Virginia Forest Service is of the opinion that some 250,000 acres of land in the Piedmont require planting; a large share of this land lies within the Central Section.

The problems of the section also call for an enlarged program of research bearing upon silvicultural and economic aspects of forestry. How to combat hardwood conversion, or perhaps in some measure to adapt utilzation to the trend in hardwoods, is a pressing question. But the fundamental question concerns the productivity of forest lands in the section -- what is land worth under forest management; what population can it reasonably support?

Southern Flue-Wood Section

In the Southern Flue-Wood Section, comprising some 2,450,000 acres, production of flue-cured, or bright-fired, tobacco overshadows other farm enterprises and places a large burden upon the forests to produce the wood required for tobacco curing. This drain is in addition to the heavy drain for ordinary fuel wood and for pine lumber and pulpwood.

While less heavily wooded than the Central Pine-Hardwood Section, the Southern Flue-Wood Section nevertheless is comprised in large measure of forested land -- chiefly stands of the shortleaf-pine type occurring as small, isolated woodlands on each farm (fig. 33).

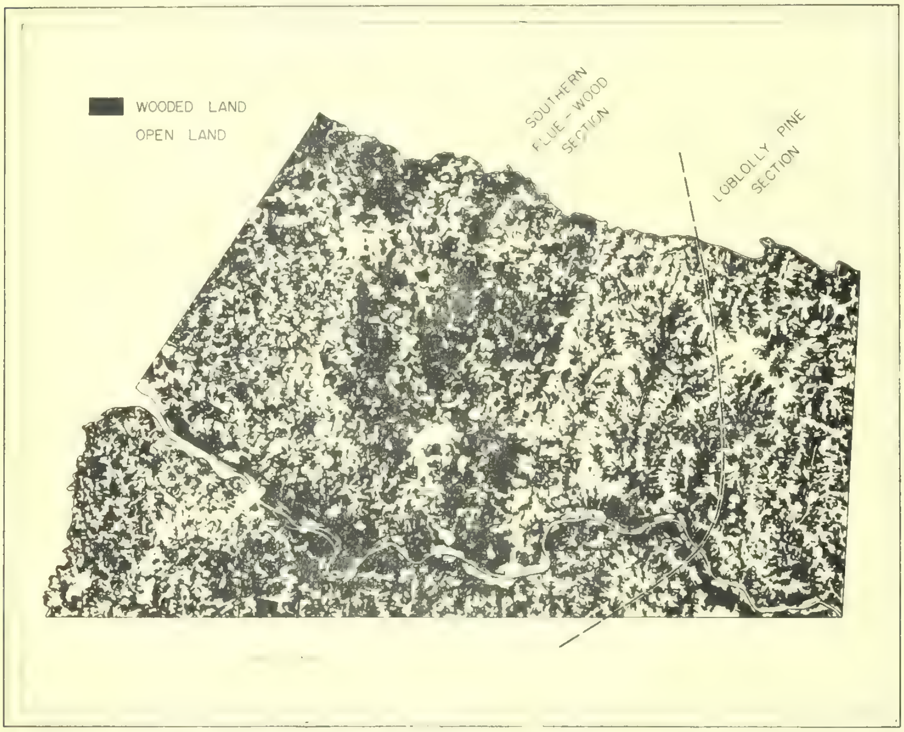

Figure 33. -- Location of wooded lands in Mecklenburg County, Virginia.

The heavy demand for forest products of all types had produced a higher rate of drain in proportion to growing stock in this section than in any other in Piedmont Virginia and has led to a marked scarcity of timber in many localities. This, in turn, has resulted in a more general recognition of the value of timber than is to be found elsewhere in the Piedmont.

Since it requires about 2-1/2 cords of wood to cure the crop harvested from each acre of tobacco land, and since returns under management in the near future promise to average about one-half cord per acre per year, it is necessary for the self-sufficient farm to have in woodland, for flue-wood alone, about 5 times its tobacco acreage. Adding to this the farm needs for fuel wood, fence posts, and repair lumber, it appears that the average tobacco farm now requires 45 acres of woods in fair condition to supply all home needs for forest products. With the typical size of farm woodlands in the section ranging between 40 and 50 acres, the chief function of woodlands for the present should apparently be to supply wood for the farm itself: only the larger and more productive tracts may properly be expected to yield cash income. In this light, the extent to which woods depletion is resulting from the heavy cut of lumber within the section (see fig. 25) is particularly apparent.

Tobacco production creates several other special forestry problems within the section. Tobacco plant beds are customarily located in the woods, and the clearings made for this purpose should subsequently be given careful management to prevent their lying idle for years under the cover of brush which generally takes possession of the ground. More important is the problem of tenancy, considerably more prevalent in this section than elsewhere in Piedmont Virginia. More than half of all farms are operated by tenants. It is customary for tenants to cut their flue and fuel wood from the farm forest, but seldom is any restriction placed upon the manner of cutting -- either in the lease or through supervision. Unrestricted, and having no interest in the woods as a continuing resource, the tenant cuts those trees most easily made into fire wood -- usually the straightest, least limby, and therefore most valuable pines, which show the greatest promise for higher uses. A program of timber marking for fire-wood cuttings, perhaps managed and financed cooperatively by landlords, would do much to alleviate this problem.

In the eastern part of the section, where the shortleaf-pine forests predominate, depleted fields are being invaded by Virginia pine, at great loss of forest productivity. How to check the spread of this inferior pine is an important question.

Loblolly Pine Section

The Loblolly Pine Section, embracing a narrow strip of about 370,000 acres in six of the southeastern counties, forms the western edge of the extensive pine lands of eastern Virginia. Heavily forested, and containing the best pine sites in the Piedmont, the section is nevertheless of secondary importance as a part of the Piedmont because of its restricted area. Its forestry conditions and problems are largely those of the loblolly-pine lands of the Coastal Plain.

Activities of Public & Private Agencies

A number of agencies, public and private, are now conducting programs of action and research in forestry in Piedmont Virginia.

Nine pulp mills operate in the State, all of them drawing some wood from the Piedmont. Of these, four have active forestry departments (all but one organized since 1939) which manage company lands and give management advice and assistance to private owners from whom they purchase pulpwood.

The Virginia Forest Service engages in four major lines of activity: (1) Fire protection, about 85 percent of the State Forest Service work. The cooperative Federal-State-county protection system is extended to 32 of the Piedmont's 35 counties, with another county to be added in 1944 on the basis of increased appropriations received for the present biennium. (2) Management of State forests, not yet fully under way. In addition, the Forest Service administers several small county forests in the district. (3) Directing work of the State camps of the Civilian Conservation Corps (an activity now suspended) and maintaining CCC improvements, particularly fire roads, trails, and telephone lines. (4) Giving management advice and assistance to private non-farm forest owners. One man is normally assigned to work throughout the State. The Forest Service also maintains a Clarke-McNary nursery distributing at cost about 2 million tree seedlings per year for forest planting.

In the field of formal education, both the University of Virginia and the Virginia Polytechnic Institute conduct forestry courses. The latter has recently set up a one-term course in general forestry as a requirement for the degree in agriculture.

The State Agricultural Extension Service, through the Extension Forester, carries a program of education and technical assistance to farm-woodland owners, helping them with all phases of timber management and marketing. During the past decade it has made considerable progress in promoting forestry-mindedness among farmers and county agricultural agents, stimulating many of these agents to undertake constructive forestry programs in their counties.

The Virginia State Planning Board has made general surveys of the forestry situation in connection with its reports on natural resources, agriculture, and industry. At present it is the coordinating agency in a joint project with the State University and Agricultural College -- a project aimed at land-use classification and a related study of population and small industry, and thus having a close bearing upon forestry problems.

The U. S. Soil Conservation Service is the administrative agency in the soil conservation districts, organized in accordance with the State enabling act of 1938. Twenty-two of the Piedmont's 35 counties are now in conservation districts. Farm-management plans, including the woods in more or less detail, are prepared for cooperating farms. In one district a technical forester prepares detailed woods-management plans for a limited number of cooperators and advises them on timber cutting and marketing. Through its C.C.C. camps the Soil Conservation Service has conducted cutting and improvement operations and set up demonstrations in private woodlands. It maintains nurseries and distributes forest planting stock to cooperators.

The U. S. Forest Service administers two national forests in the Mountain Hardwoods Section of the region. These forests include 85,000 acres within the section, with a gross purchase-unit area of 223,000 acres: more than a fourth of the section's total area. Through the Appalachian Forest Experiment Station it conducts research in forest management, fire control, forest-water relationships, and some of the economic aspects of timber supply, production, and industrial uses. It maintains the Lee Experimental Forest in Buckingham County as a field research laboratory and as a going demonstration in the business of forest management.

The Tennessee Valley Authority cooperates with a number of farmers in Piedmont Virginia as a part of its phosphate-fertilizer demonstration program. Plans prepared for these farms in some cases consider the place of the woodland in the farm business and contain a few general recommendations for woods management.

The Farm Security Administration, also, gives some attention to the needs of farm forestry on its clients' farms. It is currently preparing for more intensive work in the forestry field and is cooperating with the U. S. Forest Service in giving to its county supervisors a brief schooling in practical forestry.

The Agricultural Adjustment Administration recognizes tree planting and forest-stand improvement as soil-conserving practices. In 1940 it provided a special allotment of $30 per farm which could be earned through forestry practices. (This allotment was subsequently reduced to $15, and then eliminated, but payments out of the general allotment are still obtainable on the same basis as before 1940). Farmers' response has, on the whole, been meager. During the 6-year period 1936-41, an average of only 220 acres was planted annually in the entire district, and an average of only 35 acres of woods improved.

From a review of the forestry activities of these agencies it appears that with only one or two outstanding exceptions the essential framework of a sound forestry program is already well developed. The chief need along these lines is for an increased tempo of activity -- an objective now, of course, largely to be postponed until after the war. In the field of extension and technical assistance 3 or 4 men now serve on a part-time basis where probably at least 10 full time workers are needed to do an effective job. The State fire-protection system, left over-expanded by retirement of the Civilian Conservation Corps, greatly needs strengthening, and general educational programs in fire prevention also require considerable enlargement.

A number of agencies dealing with the farm as a business unit are apparently beginning to give some attention to the farm woods. There is little evidence, however, that they regard farm forestry as an integral and productive part of the farm business. Methods of appraisal and of farm budgeting largely ignore the existence of the woodland. In Piedmont Virgnina, with its great aggregate of non-agricultural soils and its economic future so closely dependent upon the future of forest labor and industry, it is difficult to see how these agencies can make real progress toward their objective of social betterment without coming definitely to grips with the forestry situation.

Two important fields of forestry activity have so far seen scanty progress. The first is public regulation of cutting practices. As regards State action, the General Assembly of Virginia has in committee considered the need for such legislation but has to date merely evolved two rather ineffective seed-tree laws. The second neglected field is that of the distribution of forest products. While marketing problems can be fully met only after some regeneration of the forest resource, measures can be taken now to improve the situation. Furthermore, research in forest-products distribution is urgently needed to uncover all the facts and provide a basis for a well-rounded program.

Recommendations in Summary

The following, then, appear to be the outstanding needs of the forest situation in Piedmont Virginia:

A. Education and technical assistance in forestry
    1. To promote forestry-mindedness among the people
    2. To combat carelessness with fire.
    3. To increase the effectiveness of public forest regulation, when adopted.
    4. To give concrete assistance to woods owners in --
        a. Developing forest-management plans
        b. Estimating timber volumes and marking timber for cutting
        c. Marketing forest products.
    5. To promote increased efficiency and better utilization in small sawmills.

B. Public control of timber-cutting practices.
    1. To stop forest exploitation
    2. To permit rebuilding the forest as a source of income
    3. To lay foundations for increasing the efficiency of timber marketing

C. Public forest acquisition
    1. By the State, an estimated 380,000 acres east of the foothills.
    2. By the Federal government, an estimated 140,000 acres in the Mountain Section.

D. Forest research.
    1. To develop economic methods of forest management, aimed at producing trees favored commercially
    2. To evaluate present and potential contribution of forests to local income as a basis for planning needed population and land-use adjustments.
    3. To study the problems of timber marketing and suggest means of solving them
    4. To provide in part the facts needed in land-use classification and zoning

E. Resource rehabilitation through public works
    1. To provide post-war employment.
    2. To create a permanently productive forest.
    3. To give practical education in forest conservation.

F. Other public forestry measures.
    1. Intensification of forest-fire protection.
    2. Rehabilitation, possibly through forest planting, of about 250,000 acres, to reclaim idle land and arrest soil erosion.

3. Credit extension to woodland owners to make conservative cutting financially possible.
4. Greater attention to farm forestry on the part of agricultural extension and service agencies.

G. Private forestry measures.
   1. Steps by pulp and lumber companies and concentration yards to correct remediable defects in their buying practices so as to promote better forestry practice and higher forest income.
   2. Action by landlords to clarify wood-cutting privileges and requirements on tenant farms, and by other owners to encourage sound cutting practices on their woodlands.

Many of these forestry measures are to be regarded as part of a post-war program. Aims in that period would be, first, to provide useful employment for persons released from war activities; second, to rebuild a productive forest resource, depleted through two centuries of mismanagement and currently undergoing especially severe strain because of the war itself.

Modern war places the heaviest of demands upon all natural resources. High prices and enlarged requirements for pulpwood, sawlogs, ties, and other forest products call urgently for maximum timber production, even in a region like Piedmont Virginia, whose impoverished forests were already overburdened to the limit. War has not only accelerated cutting but it has also led to an increase in undesirable cutting practices -- heavier cutting of forest stands and the lowering of requirements standards by wood-using industries.

During the past war Piedmont forests were called upon for a similar, though less extreme, effort of production. They emerged heavily scarred from that conflict. They have entered the present war less well prepared than before to furnish the timber so urgently needed. They will undoubtedly emerge from this war in a still less productive condition. Very little can be done now to alter the fact of forest impoverishment. But in the post-war period something can and must be done. The forests of Piedmont Virginia must be better prepared to meet the demands of future emergencies. But in addition, and even more important, they must be equipped to provide the people of the district with decent levels of employment and income in the years of peace.

Section 5. -- APPENDIX

Glossary

Forest Type

Softwood types (loblolly pine-, shortleaf pine-, Virginia pine-, white pine-, and redcedar-hardwoods). -- Stands in which softwoods comprise 25 percent or more of the number of dominant and codominant trees, with the designated softwood species predominating. In the appendix tables, statistics for the white pine-and redcedar-hardwoods types are included with those for the cove-hardwoods and shortleaf pine-hardwoods types, respectively.

Bottomland hardwoods. -- Stands in which hardwoods make up more than 75 percent of the number of dominant and codominant trees; usually found along stream margins and river bottoms

Cove hardwoods. -- Stands in which yellowpoplar and other hardwoods make up more than 75 percent of the number of dominant and codominant trees; usually found on lower mountain slopes and coves with northerly or easterly exposure.

Upland hardwoods. -- Stands in which mixed oaks and other hardwoods make up more than 75 percent of the number of dominant and codominant trees; usually found on rolling, upland sites.

Diameter

Tree diameter. -- Diameter outside bark, in inches, measured 4-1/2 feet above ground

Diameter class. -- Includes a 2-inch range of tree diameters. The 10-inch diameter class includes trees from 9.0 to 10.9 inches in diameter; the 12-inch class, trees from 11.0 to 12.9 inches, and so on.

Tree Classification

Sound, sawlog-size tree. -- A softwood tree 9.0 inches or more in diameter, or a hardwood tree 13.0 inches or more, with not less than one sound 12-foot butt log, or with 50 percent of the gross board-foot volume of the tree in usable sawlogs

Sound tree under sawlog size. -- Any sound, straight-stemmed tree between 1.0 inch in diameter and sawlog size

Cull tree. -- A tree which -- because of poor form, limbiness, rot, or other defect -- fails to qualify as a sound tree

Pole tree. -- A pine tree that will produce a pole conforming to specifications of the American Standards Association.

Forest Condition

Old-growth saw-timber stand. -- A stand having the characteristics of the original mature timber of the region, containing at least 1,000 board feet of sawlogs per acre in the case of hardwood types, 600 board feet in the case of softwood types.

Second-growth saw-timber stand. -- A stand of second growth containing at least 600 board feet per acre.

Cordwood stand. -- A stand of second growth containing less than 600 board feet per acre.

Reproduction stand. -- A nonsawtimber, non-cordwood stand containing at least 80 well distributed seedlings per acre. Statistics for this condition include those for the clear-cut condition -- i.e., cut-over areas having insufficient young growth to qualify as either cordwood or reproduction.

Volume

Board-foot volume. -- The volume by International 1/4-inch rule, exclusive of defect, of that portion of living, sound, sawlog-size trees lying between stump and the upper limit of merchantability for sawlogs.

Volume in cords. -- The volume of wood and bark in standard cords, exclusive of defect, of that portion of living trees 5.0 inches and larger in diameter lying between stump and a top of approximately 4 inches minimum diameter outside bark.

Cubic-foot volume. -- The solid cubic volume of all wood (not bark) included in the cordwood estimate.

Growth and Utilization

Growing stock. -- The volume of timber exclusive of cull trees and hardwood tops.

Mortality. -- The volume lost from the growing stock through the death of trees, caused by fire, tree competition, disease, insect damage, and windthrow.

Net growth. -- The net increase (mortality deducted) in growing stock, before subtracting commodity drain.

Commodity drain. -- The reduction in growing stock due to cutting within the designated area.

Production. -- The volume of forest products manufactured or consumed by forest industry within the designated area.

Forest Survey Unit

Northern Piedmont. -- Unit No. 3, comprised of the Piedmont counties situated north of the James River (see fig. 1).

Southern Piedmont. -- Unit No. 2, comprised of the Piedmont counties situated south of the James River (see fig. 1).

Table 11. -- Land area by type of use, 1940

Type of use	Area in acres			Percent of total land area		
	Entire Piedmont	Northern Piedmont	Southern Piedmont	Entire Piedmont	Northern Piedmont	Southern Piedmont
Forest land:						
Commercial forest....	5,827,900	2,405,900	3,422,000	57.9	54.4	60.7
Reserved public forest	104,300	98,100	6,200	1.0	2.2	.1
All forest land....	5,932,200	2,504,000	3,428,200	58.9	56.6	60.8
Non-forest land:						
Active farm land:						
Pasture.............	1,064,700	702,500	362,200	10.6	15.9	6.4
Crop land and other farm land..........	2,621,300	1,014,300	1,607,000	26.0	22.9	28.5
All active farm land	3,686,000	1,716,800	1,969,200	36.6	38.8	34.9
Abandoned farm land...	220,400	93,700	126,700	2.2	2.1	2.2
Other non-forest land.	227,900	109,800	118,100	2.3	2.5	2.1
All non-forest land.	4,134,300	1,920,300	2,214,000	41.1	43.4	39.2
All land..............	10,066,500	4,424,300	5,642,200	100.0	100.0	100.0

Table 12. -- Forest area by forest type and condition, 1940

ENTIRE PIEDMONT

Forest type	All conditions		Saw-timber stands		Cordwood stands	Reproduction stands
			Old growth	Second growth		
	Acres	Percent	Acres	Acres	Acres	Acres
Loblolly pine-hardwoods..	96,400	1.6	....	49,500	31,600	15,300
Shortleaf pine-hardwoods.	1,233,100	21.2	11,300	670,300	480,700	70,800
Virginia pine-hardwoods..	1,391,500	23.9	2,400	472,100	731,200	185,800
Bottom-land hardwoods....	334,100	5.7	10,400	182,100	129,600	12,000
Cove hardwoods...........	185,700	3.2	6,300	116,600	62,800	....
Upland hardwoods.........	2,587,100	44.4	73,200	1,116,500	1,272,100	125,300
All types..............	5,827,900	....	103,600	2,607,100	2,708,000	409,200
			Percent	Percent	Percent	Percent
	....	100.0	1.8	44.7	46.5	7.0

NORTHERN PIEDMONT

Forest type	All conditions		Saw-timber stands		Cordwood stands	Reproduction stands
			Old growth	Second growth		
			Acres	Acres	Acres	Acres
Loblolly pine-hardwoods..	7,100	.3	....	2,400	3,200	1,500
Shortleaf pine-hardwoods.	245,700	10.2	1,600	120,500	103,100	20,500
Virginia pine-hardwoods..	639,500	26.6	1,600	198,400	353,600	85,900
Bottom-land hardwoods....	148,100	6.1	5,500	73,300	63,000	6,300
Cove hardwoods...........	110,200	4.6	4,700	62,200	43,300	....
Upland hardwoods.........	1,255,300	52.2	49,600	521,300	639,500	44,900
All types..............	2,405,900	......	63,000	978,100	1,205,700	159,100
			Percent	Percent	Percent	Percent
	....	100.0	2.6	40.7	50.1	6.6

SOUTHERN PIEDMONT

Forest type	All conditions		Saw-timber stands		Cordwood stands	Reproduction stands
			Old growth	Second growth		
			Acres	Acres	Acres	Acres
Loblolly pine-hardwoods	89,300	2.6	.....	47,100	28,400	13,800
Shortleaf pine-hardwoods.	987,400	28.9	9,700	549,800	377,600	50,300
Virginia pine-hardwoods..	752,000	22.0	800	273,700	377,600	99,900
Bottom-land hardwoods....	186,000	5.4	4,900	108,800	66,600	5,700
Cove hardwoods...........	75,500	2.2	1,600	54,400	19,500	....
Upland hardwoods.........	1,331,800	38.9	23,600	595,200	632,600	80,400
All types..............	3,422,000	....	40,600	1,629,000	1,502,300	250,100
			Percent	Percent	Percent	Percent
	....	100.0	1.2	47.6	43.9	7.3

Table 13. -- Species composition of forest types, 1940[1]

Tree species	All forest types	Loblolly pine hardwoods	Shortleaf pine hardwoods	Virginia pine hardwoods	Bottomland hardwoods	Cove hardwoods	Upland hardwoods
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Softwoods:							
Loblolly pine.....	1.6	64.4	.8	.2	.6	....	.2
Shortleaf pine....	19.0	8.5	63.5	9.7	2.3	1.4	3.7
Virginia pine.....	14.4	.8	7.3	60.9	1.0	2.0	2.2
White pine, hemlock	.7	....	.1	.4	.1	8.9	.4
Redcedar..........	.3	.1	.7	.4	.2	.1	.2
All softwoods...	36.0	73.8	72.4	71.6	4.2	12.4	6.7
Hardwoods:							
Northern red oak..	3.7	.1	.9	.7	2.1	6.6	6.5
Other red oaks....	10.3	3.2	6.1	6.1	5.7	5.0	16.3
White oak.........	13.2	3.3	4.7	5.3	3.8	5.3	24.3
Chestnut oak......	5.2	....	.6	.5	.1	4.3	11.1
Other white oaks..	1.4	.8	1.2	1.4	.7	.5	1.9
Red maple.........	2.1	1.0	.9	.9	7.4	2.3	2.5
Black tupelo......	1.6	1.0	.6	.8	1.2	2.0	2.6
Sweetgum..........	3.7	9.4	3.5	1.6	16.4	.2	2.7
Yellowpoplar......	11.2	4.5	5.7	7.2	15.1	45.4	11.6
Beech.............	.8	.1	.1	.1	.9	.6	1.5
Hickory...........	4.0	.5	1.3	1.3	1.3	3.6	7.4
Ash...............	1.1	.2	.2	.2	8.1	1.9	.6
Scrub hardwoods...	.8	.2	.4	.6	.8	1.5	1.0
Other hardwoods...	4.9	1.9	1.4	1.7	32.2	8.4	3.3
All hardwoods...	64.0	26.2	27.6	28.4	95.8	87.6	93.3
All species........	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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[1] Cubic-foot volume in each species, expressed as a percentage of the total volume for the type -- average of all stands sampled in Piedmont Virginia.

Table 14. -- Saw-timber volume -- International $\frac{1}{4}$-inch Scribner, and Doyle rules -- by tree species, 1940

ENTIRE PIEDMONT

Tree species	International $\frac{1}{4}$-inch rule	Scribner rule	Doyle rule
	M bd. ft.	M bd. ft.	M bd. ft.
Softwoods:			
Shortleaf and loblolly pines...	1,973,900	1,631,600	1,005,200
Virginia pine..................	1,058,400	858,600	497,600
Other softwoods................	116,600	100,000	70,300
All softwoods..................	3,148,900	2,590,200	1,573,100
Hardwoods:			
Northern red oak...............	437,700	402,600	341,100
Other red oaks.................	686,500	623,300	497,100
White oaks.....................	1,261,700	1,148,800	931,100
Red maple......................	108,400	97,800	75,500
Sweetgum.......................	243,300	219,300	168,600
Yellowpoplar...................	1,002,200	908,000	715,700
Hickory........................	254,600	229,900	177,900
Other hardwoods................	467,100	422,500	329,700
All hardwoods..................	4,461,500	4,052,200	3,236,700
All species....................	7,610,400	6,642,400	4,809,800

Table 15.-- Saw-timber volume, International $\frac{1}{4}$-inch rule, by tree species and forest condition, 1940

ENTIRE PIEDMONT

Tree species	All conditions		Saw-timber stands		Cordwood and reproduction stands
			Old growth	Second growth	
	M bd. ft.	Percent	M bd. ft.	M bd. ft.	M bd. ft.
Softwoods:					
Loblolly pine......	220,000	2.9	200	215,100	4,700
Shortleaf pine.....	1,753,900	23.1	88,000	1,557,800	108,100
Virginia pine......	1,058,400	13.9	10,100	956,600	91,700
Other softwoods....	116,600	1.5	13,300	94,700	8,600
All softwoods....	3,148,900	41.4	111,600	2,824,200	213,100
Hardwoods:					
Northern red oak...	437,700	5.8	91,900	338,800	7,000
Other red oaks.....	686,500	9.0	61,800	587,800	36,900
White oak..........	843,300	11.1	146,200	659,600	37,500
Chestnut oak.......	353,200	4.6	76,200	257,600	19,400
Other white oaks...	65,200	.9	2,000	58,200	5,000
Red maple..........	108,400	1.4	6,800	94,200	7,400
Black tupelo.......	78,800	1.0	4,100	70,300	4,400
Sweetgum...........	243,300	3.2	29,200	204,200	9,900
Yellowpoplar.......	1,002,200	13.2	28,100	935,800	38,300
Beech..............	62,100	.8	4,900	53,800	3,400
Hickory............	254,600	3.3	21,300	217,800	15,500
Ash................	54,700	.7	9,300	42,400	3,000
Other hardwoods....	271,500	3.6	35,400	223,800	12,300
All hardwoods....	4,461,500	58.6	517,200	3,744,300	200,000
All species..........	7,610,400	100.0	628,800	6,568,500	413,100

Table 15. -- Saw-timber volume, International $\frac{1}{4}$-inch rule, by tree species and forest condition, 1940 -- Continued

NORTHERN PIEDMONT

Tree species	All conditions		Saw-timber stands		Cordwood and reproduction stands
			Old growth	Second growth	
	M bd. ft.	Percent	M bd. ft	M bd. ft.	M bd. ft.
Softwoods:					
Loblolly pine........	13,500	.5	200	13,300	....
Shortleaf pine.......	312,800	11.3	8,600	272,300	31,900
Virginia pine........	454,300	16.4	4,200	405,200	44,900
Other softwoods......	57,100	2.0	13,200	40,700	3,200
All softwoods......	837,700	30.2	26,200	731,500	80,000
Hardwoods:					
Northern red oak.....	242,100	8.7	60,700	176,200	5,200
Other red oaks.......	304,100	11.0	42,900	241,600	19,600
White oak............	414,800	15.0	84,900	309,100	20,800
Chestnut oak.........	216,100	7.8	60,600	147,000	8,500
Other white oaks.....	16,700	.6	500	14,000	2,200
Red maple............	37,100	1.3	900	33,600	2,600
Black tupelo.........	31,800	1.1	300	29,800	1,700
Sweetgum.............	58,100	2.1	5,300	51,000	1,800
Yellowpoplar.........	364,300	13.2	8,000	341,800	14,500
Beech................	24,500	.9	600	22,500	1,400
Hickory..............	111,700	4.0	7,600	97,800	6,300
Ash..................	15,700	.6	900	13,700	1,100
Other hardwoods......	95,600	3.5	19,100	71,200	5,300
All hardwoods......	1,932,600	69.8	292,300	1,549,300	91,000
All species............	2,770,300	100.0	318,500	2,280,800	171,000

Table 15. -- Saw-timber volume, International ¼-inch rule, by tree species and forest condition, 1940 -- Continued

SOUTHERN PIEDMONT

Tree species	All conditions		Saw-timber stands		Cordwood and reproduction stands
			Old growth	Second growth	
	M bd. ft.	Percent	M bd. ft.	M bd. ft.	M bd. ft.
Softwoods:					
Loblolly pine.......	206,500	4.3	....	201,800	4,700
Shortleaf pine......	1,441,100	29.8	79,400	1,285,500	76,200
Virginia pine.......	604,100	12.5	5,900	551,400	46,800
Other softwoods.....	59,500	1.2	100	54,000	5,400
All softwoods.....	2,311,200	47.8	85,400	2,092,700	133,100
Hardwoods:					
Northern red oak....	195,600	4.0	31,200	162,600	1,800
Other red oaks......	382,400	7.9	18,900	346,200	17,300
White oak...........	428,500	8.9	61,300	350,500	16,700
Chestnut oak........	137,100	2.8	15,600	110,600	10,900
Other white oaks....	48,500	1.0	1,500	44,200	2,800
Red maple...........	71,300	1.5	5,900	60,600	4,800
Black tupelo........	47,000	1.0	3,800	40,500	2,700
Sweetgum............	185,200	3.8	23,900	153,200	8,100
Yellowpoplar........	637,900	13.2	20,100	594,000	23,800
Beech...............	37,600	.8	4,300	31,300	2,000
Hickory.............	142,900	2.9	13,700	120,000	9,200
Ash.................	39,000	.8	8,400	28,700	1,900
Other hardwoods.....	175,900	3.6	16,300	152,600	7,000
All hardwoods.....	2,528,900	52.2	224,900	2,195,000	109,000
All species..........	4,840,100	100.0	310,300	4,287,700	242,100

Table 16. -- Saw-timber volume, International $\frac{1}{4}$-inch rule, by tree species and diameter class, 1940

ENTIRE PIEDMONT

Tree species	Diameter class (inches)				
	All classes	10-12	14-18	20-24	26 and larger
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.
Softwoods:					
Shortleaf and loblolly pines.......	1,973,900	1,217,300	643,500	101,100	12,000
Virginia pine.......	1,058,400	786,500	265,200	6,700	....
Other softwoods.....	116,600	47,500	36,500	20,300	12,300
All softwoods....	3,148,900	2,051,300	945,200	128,100	24,300
	Percent	Percent	Percent	Percent	Percent
	100.0	65.1	30.0	4.1	.8
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.
Hardwoods:					
Northern red oak....	437,700	....	162,300	138,500	136,900
Other red oaks......	686,500	....	398,700	209,300	78,500
White oaks..........	1,261,700	....	682,400	360,400	218,900
Red maple...........	108,400	....	76,400	23,000	9,000
Sweetgum............	243,300	....	183,500	40,300	19,500
Yellowpoplar........	1,002,200	....	638,200	288,200	75,800
Hickory.............	254,600	....	182,700	53,000	18,900
Other hardwoods.....	467,100	....	313,900	115,600	37,600
All hardwoods....	4,461,500	....	2,638,100	1,228,300	595,100
	Percent	Percent	Percent	Percent	Percent
	100.0	....	59.1	27.5	13.4
	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.	M bd. ft.
All species..........	7,610,400	2,051,300	3,583,300	1,356,400	619,400
	Percent	Percent	Percent	Percent	Percent
	100.0	27.0	47.1	17.8	8.1

Table 17. -- Saw-timber volume per acre, International $\frac{1}{4}$-inch rule, by forest type and condition, 1940

Forest type	All conditions	Saw-timber stands: All	Saw-timber stands: Old growth	Saw-timber stands: Second growth	Cordwood and reproduction stands
	Bd. ft.	Bd. ft.	Bd. ft.	Bd. ft.	Bd. ft.
ENTIRE PIEDMONT					
Loblolly pine-hardwoods......	2,120	4,050	....	4,050	80
Shortleaf pine-hardwoods.....	1,570	2,720	7,510	2,640	140
Virginia pine-hardwoods......	950	2,570	6,170	2,550	110
Bottom-land hardwoods........	1,750	2,920	7,500	2,660	150
Cove hardwoods...............	2,500	3,640	7,050	3,460	260
Upland hardwoods.............	1,200	2,450	5,560	2,240	140
All types....................	1,310	2,660	6,070	2,520	130
NORTHERN PIEDMONT					
Loblolly pine-hardwoods......	510	1,500	....	1,500	....
Shortleaf pine-hardwoods.....	1,280	2,440	7,060	2,380	140
Virginia pine-hardwoods......	840	2,440	5,940	2,410	110
Bottom-land hardwoods........	1,420	2,550	4,820	2,380	150
Cove hardwoods...............	2,260	3,570	6,660	3,330	240
Upland hardwoods.............	1,160	2,400	4,840	2,170	130
All types....................	1,150	2,500	5,060	2,330	130
SOUTHERN PIEDMONT					
Loblolly pine-hardwoods......	2,250	4,180	....	4,180	90
Shortleaf pine-hardwoods....	1,640	2,780	7,590	2,700	140
Virginia pine-hardwoods......	1,050	2,670	6,620	2,660	120
Bottom-land hardwoods........	2,000	3,180	10,510	2,850	150
Cove hardwoods...............	2,850	3,740	8,190	3,600	300
Upland hardwoods.............	1,240	2,490	7,070	2,310	150
All types....................	1,410	2,750	7,640	2,630	140

Table 18. -- Volume in cords, by tree species and type of material, 1940

ENTIRE PIEDMONT

Tree species	All types of material		All sound material	Saw timber trees		Sound trees under sawlog size	Cull trees
				Sawlog material	Upper stems		
	M cords	Percent	M cords	M cords	M cords	M cords	M cords
Softwoods:							
Loblolly pine...	1,024.3	1.4	1,013.0	558.7	132.6	321.7	11.3
Shortleaf pine..	12,460.3	17.1	12,185.6	5,253.8	1,507.7	5,424.1	274.7
Virginia pine...	8,895.6	12.2	7,916.8	2,702.2	872.3	4,342.3	978.8
Other softwoods.	621.4	0.9	587.3	264.1	53.6	269.6	34.1
All softwoods.	23,001.6	31.6	21,702.7	8,778.8	2,566.2	10,357.7	1,298.9
Hardwoods:							
Northern red oak	2,732.7	3.8	2,413.6	1,055.0	663.0	695.6	319.1
Other red oaks..	7,710.9	10.6	6,998.9	1,987.2	1,078.3	3,933.4	712.0
White oak.......	9,553.6	13.1	8,795.8	2,381.2	1,341.2	5,073.4	757.8
Chestnut oak....	4,746.4	6.6	3,779.7	1,112.7	573.5	2,093.5	966.7
Other white oaks	1,309.4	1.8	1,054.5	215.8	108.1	730.6	254.9
Red maple.......	2,191.4	3.0	1,369.9	298.5	171.6	899.8	821.5
Black tupelo....	1,439.9	2.0	1,094.8	232.9	125.7	736.2	345.1
Sweetgum........	2,650.2	3.7	2,481.1	590.5	351.9	1,538.7	169.1
Yellowpoplar....	8,237.1	11.3	7,663.4	2,707.4	1,470.3	3,485.7	573.7
Beech...........	659.7	0.9	490.2	174.2	103.6	212.4	169.5
Hickory.........	3,122.0	4.3	2,876.1	823.6	434.4	1,618.1	245.9
Ash.............	950.3	1.3	722.5	151.7	80.5	490.3	227.8
Other hardwoods.	4,371.8	6.0	3,081.5	724.0	429.1	1,928.4	1,290.3
All hardwoods	49,675.4	68.4	42,822.0	12,454.7	6,931.2	23,436.1	6,853.4
All species......	72,677.0	....	64,524.7	21,233.5	9,497.4	33,793.8	8,152.3
		Percent	Percent	Percent	Percent	Percent	Percent
	....	100.0	88.8	29.2	13.1	46.5	11.2
Chestnut.........	2,898.5	......	.....	....	......	....	......

Table 18. -- Volume in cords, by tree species and type of material, 1940-
Continued

NORTHERN PIEDMONT

Tree species	All types of material		All sound material	Saw-timber trees		Sound trees under sawlog size	Cull trees
				Sawlog material	Upper stems		
	M cords	Percent	M cords	M cords	M cords	M cords	M cords
Softwoods:							
Loblolly pine...	57.6	0.2	57.6	34.3	9.1	14.2	....
Shortleaf pine..	2,672.1	9.2	2,581.9	998.7	301.2	1,282.0	90.2
Virginia pine...	3,962.0	13.6	3,507.6	1,162.4	379.9	1,965.3	454.
Other softwoods.	268.4	0.9	256.4	129.3	27.9	99.2	12.0
All softwoods	6,960.1	23.9	6,403.5	2,324.7	718.1	3,360.7	556.6
Hardwoods:							
Northern red oak	1,563.7	5.4	1,326.1	587.8	366.9	371.4	237.6
Other red oaks..	3,325.7	11.4	3,008.1	875.4	477.7	1,655.0	317.6
White oak.......	5,058.9	17.4	4,646.6	1,188.1	658.0	2,800.5	412.3
Chestnut oak....	2,753.1	9.5	2,137.7	682.1	352.4	1,103.2	615.4
Other white oaks	490.3	1.7	380.0	57.6	26.9	295.5	110.3
Red maple.......	807.1	2.8	459.0	99.9	58.4	300.7	348.1
Black tupelo....	537.5	1.8	389.3	93.3	50.6	245.4	148.2
Sweetgum........	730.8	2.5	674.6	142.3	84.2	448.1	56.2
Yellowpoplar....	3,168.3	10.9	2,878.9	983.6	534.6	1,360.7	289.4
Beech...........	300.9	1.0	220.7	69.0	40.9	110.8	80.2
Hickory.........	1,546.0	5.3	1,394.5	369.3	190.4	834.8	151.5
Ash.............	345.7	1.2	234.7	44.1	23.1	167.5	111.0
Other hardwoods.	1,525.1	5.2	1,093.3	253.6	151.1	688.6	431.8
All hardwoods	22,153.1	76.1	18,843.5	5,446.1	3,015.2	10,382.2	3,309.6
All species......	29,113.2	......	25,247.0	7,770.8	3,733.3	13,742.9	3,866.2
			Percent	Percent	Percent	Percent	Percent
	....	100.0	86.7	26.7	12.8	47.2	13.3
Chestnut.........	1,803.4	......	....	....	....	......	....

Table 18. --Volume in cords, by tree species and type of material, 1940 --Continued

SOUTHERN PIEDMONT

Tree species	All types of material		All sound material	Saw-timber trees		Sound trees under sawlog size	Cull trees
				Sawlog material	Upper stems		
	M cords	Percent	M cords	M cords	M cords	M cords	M cords
Softwoods:							
Loblolly pine	966.7	2.2	955.4	524.4	123.5	307.5	11.3
Shortleaf pine	9,788.2	22.5	9,603.7	4,255.1	1,206.5	4,142.1	184.5
Virginia pine	4,933.6	11.3	4,409.2	1,539.8	492.4	2,377.0	524.4
Other softwoods	353.0	0.8	330.9	134.8	25.7	170.4	22.1
All softwoods	16,041.5	36.8	15,299.2	6,454.1	1,848.1	6,997.0	742.3
Hardwoods:							
Northern red oak	1,169.0	2.7	1,087.5	467.2	296.1	324.2	81.5
Other red oaks	4,385.2	10.1	3,990.8	1,111.8	600.6	2,278.4	394.4
White oak	4,494.7	10.3	4,149.2	1,193.1	683.2	2,272.9	345.5
Chestnut oak	1,993.3	4.6	1,642.0	430.6	221.1	990.3	351.3
Other white oaks	819.1	1.9	674.5	158.2	81.2	435.1	144.6
Red maple	1,384.3	3.2	910.9	198.6	113.2	599.1	473.4
Black tupelo	902.4	2.1	705.5	139.6	75.1	490.8	196.9
Sweetgum	1,919.4	4.4	1,806.5	448.2	267.7	1,090.6	112.9
Yellowpoplar	5,068.8	11.6	4,784.5	1,723.8	935.7	2,125.0	284.3
Beech	358.8	0.8	269.5	105.2	62.7	101.6	89.3
Hickory	1,576.0	3.6	1,481.6	454.3	244.0	783.3	94.4
Ash	604.6	1.4	487.8	107.6	57.4	322.8	116.8
Other hardwoods	2,846.7	6.5	1,988.2	470.4	278.0	1,239.8	858.5
All hardwoods	27,522.3	63.2	23,978.5	7,008.6	3,916.0	13,053.9	3,543.8
All species	43,563.8	......	39,277.7	13,462.7	5,764.1	20,050.9	4,286.1
			Percent	Percent	Percent	Percent	Percent
	....	100.0	90.2	30.9	13.3	46.0	9.8
Chestnut	1,095.1	.....	....	.....	.....	....	....

Table 19. -- Cubic-foot volume, by tree species and type of material, 1940

ENTIRE PIEDMONT

Tree species	All types of material		All sound material	Saw-timber trees		Sound trees under sawlog size	Cull trees
				Sawlog material	Upper stems		
	M cu. ft.	Percent	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.
Softwoods:							
Shortleaf and loblolly pines...	886,120	18.8	867,420	391,850	112,540	363,030	18,700
Virginia pine.....	677,860	14.4	603,630	214,850	59,480	329,300	74,230
Other softwoods...	46,260	1.0	43,740	19,990	3,740	20,010	2,520
All softwoods...	1,610,240	34.2	1,514,790	626,690	175,760	712,340	95,450
Hardwoods:							
Oak..............	1,609,380	34.2	1,421,910	438,920	212,770	770,220	187,470
Yellowpoplar......	506,300	10.8	469,660	171,460	80,690	217,510	36,640
Hickory...........	183,360	3.9	168,510	51,270	23,200	94,040	14,850
Other hardwoods...	797,260	16.9	599,520	148,150	75,510	375,860	197,740
All hardwoods...	3,096,300	65.8	2,659,600	809,800	392,170	1,457,630	436,700
All species......	4,706,540	....	4,174,390	1,436,490	567,930	2,169,970	532,150
			Percent	Percent	Percent	Percent	Percent
	....	100.0	88.7	30.5	12.1	46.1	11.3

NORTHERN PIEDMONT

Tree species	All types of material		All sound material	Sawlog material	Upper stems	Sound trees under sawlog size	Cull trees
			M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.
Softwoods:							
Shortleaf and loblolly pines...	177,300	9.5	171,340	68,960	21,260	81,120	5,960
Virginia pine.....	301,770	16.1	267,380	92,430	25,890	149,060	34,390
Other softwoods...	19,950	1.0	19,050	9,720	1,960	7,370	900
All softwoods...	499,020	26.6	457,770	171,110	49,110	237,550	41,250
Hardwoods:							
Oak..............	811,980	43.3	706,600	220,270	106,230	380,100	105,380
Yellowpoplar......	195,060	10.4	176,540	62,300	29,350	84,890	18,520
Hickory...........	90,700	4.9	81,560	22,920	10,100	48,540	9,140
Other hardwoods...	276,900	14.8	199,660	47,980	24,470	127,210	77,240
All hardwoods...	1,374,640	73.4	1,164,360	353,470	170,150	640,740	210,280
All species......	1,873,660	....	1,622,130	524,580	219,260	878,290	251,530
			Percent	Percent	Percent	Percent	Percent
	....	100.0	86.6	28.0	11.7	46.9	13.4

SOUTHERN PIEDMONT

Tree species	All types of material		All sound material	Sawlog material	Upper stems	Sound trees under sawlog size	Cull trees
			M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.	M cu. ft.
Softwoods:							
Shortleaf and loblolly pines...	708,820	25.0	696,080	322,890	91,280	281,910	12,740
Virginia pine.....	376,090	13.3	336,250	122,420	33,590	180,240	39,840
Other softwoods...	26,310	.9	24,690	10,270	1,780	12,640	1,620
All softwoods...	1,111,220	39.2	1,057,020	455,580	126,650	474,790	54,200
Hardwoods:							
Oak..............	797,400	28.1	715,310	218,650	106,540	390,120	82,090
Yellowpoplar......	311,240	11.0	293,120	109,160	51,340	132,620	18,120
Hickory...........	92,660	3.3	86,950	28,350	13,100	45,500	5,710
Other hardwoods...	520,360	18.4	399,860	100,170	51,040	248,650	120,500
All hardwoods...	1,721,660	60.8	1,495,240	456,330	222,020	816,890	226,420
All species......	2,832,880	....	2,552,260	911,910	348,670	1,291,680	280,620
			Percent	Percent	Percent	Percent	Percent
	....	100.0	90.1	32.2	12.3	45.6	9.9

Table 20. -- Growing stock in cords, by tree species and diameter class, 1940

ENTIRE PIEDMONT

Tree species	Diameter class (inches)				
	All classes	6 - 8	10-12	14-18	20 and larger
	Cords	Cords	Cords	Cords	Cords
Softwoods:					
Shortleaf and loblolly pines....	13,198,600	5,745,800	5,279,000	1,900,900	272,900
Virginia pine.....	7,916,800	4,342,300	2,822,000	736,200	16,300
Other softwoods...	587,300	269,600	142,900	101,200	73,600
All softwoods...	21,702,700	10,357,700	8,243,900	2,738,300	362,800
	Percent	Percent	Percent	Percent	Percent
	100.0	47.7	38.0	12.6	1.7
	Cords	Cords	Cords	Cords	Cords
Hardwoods:					
Northern red oak..	1,750,600	313,900	381,700	443,800	611,200
Other red oaks....	5,920,600	1,817,400	2,116,000	1,233,500	753,700
White oaks........	11,607,200	3,427,900	4,469,600	2,168,600	1,541,100
Red maple.........	1,198,300	441,700	458,100	218,500	80,000
Sweetgum..........	2,129,200	731,400	807,300	458,700	131,800
Yellowpoplar......	6,193,100	1,624,700	1,861,000	1,791,400	916,000
Hickory...........	2,441,700	682,600	935,500	630,900	192,700
Other hardwoods...	4,650,100	1,638,100	1,664,300	959,800	387,900
All hardwoods...	35,890,800	10,677,700	12,693,500	7,905,200	4,614,400
	Percent	Percent	Percent	Percent	Percent
	100.0	29.7	35.4	22.0	12.9
	Cords	Cords	Cords	Cords	Cords
All species........	57,593,500	21,035,400	20,937,400	10,643,500	4,977,200
	Percent	Percent	Percent	Percent	Percent
	100.0	36.5	36.4	18.5	8.6

Table 21. -- Growing stock per acre in cords, by forest type and condition, 1940

ENTIRE PIEDMONT

Forest type	All conditions	Saw-timber stands		Cordwood and reproduction stands
		Old growth	Second growth	
	Cords	Cords	Cords	Cords
Loblolly pine-hardwoods	12.59	......	21.80	2.88
Shortleaf pine-hardwoods	11.98	24.64	17.66	4.82
Virginia pine-hardwoods	7.66	21.96	15.63	3.51
Bottom-land hardwoods	11.87	24.30	16.55	4.93
Cove hardwoods	14.57	22.41	18.03	7.36
Upland hardwoods	9.39	18.49	13.67	5.48
All types	9.88	20.06	15.60	4.76

NORTHERN PIEDMONT

Forest type	All conditions	Old growth	Second growth	Cordwood and reproduction stands
Loblolly pine-hardwoods	4.34	......	9.96	1.47
Shortleaf pine-hardwoods	11.43	28.62	17.65	5.13
Virginia pine-hardwoods	7.45	22.62	15.49	3.70
Bottom-land hardwoods	10.58	16.47	15.79	4.60
Cove hardwoods	13.11	21.06	17.02	6.62
Upland hardwoods	9.26	16.76	13.30	5.04
All types	9.24	17.50	14.69	4.95

SOUTHERN PIEDMONT

Forest type	All conditions	Old growth	Second growth	Cordwood and reproduction stands
Loblolly pine-hardwoods	13.24	......	22.40	3.04
Shortleaf pine-hardwoods	12.12	23.98	17.66	4.73
Virginia pine-hardwoods	7.84	20.62	15.74	3.28
Bottom-land hardwoods	12.89	33.08	17.06	5.25
Cove hardwoods	16.70	26.38	19.17	8.98
Upland hardwoods	9.51	22.14	14.00	5.33
All types	10.33	24.03	16.15	4.61

Table 22. -- Current annual net growth of saw timber, by tree species and forest condition, 1940

Tree species	All conditions		Saw-timber stands	Cordwood and reproduction stands
	M bd. ft	Percent	M bd. ft.	M bd. ft.
ENTIRE PIEDMONT				
Softwoods:				
Shortleaf, loblolly pines.........	155,800	24.9	116,000	39,800
Virginia pine......................	130,600	20.9	72,300	58,300
Other softwoods....................	6,500	1.1	4,700	1,800
All softwoods..................	292,900	46.9	193,000	99,900
Hardwoods:				
Oak................................	158,500	25.4	120,600	37,900
Gums and yellowpoplar..............	123,400	19.7	95,200	28,200
Other hardwoods....................	49,700	8.0	38,700	11,000
All hardwoods..................	331,600	53.1	254,500	77,100
All species........................	624,500	100.0	447,500	177,000
NORTHERN PIEDMONT				
Softwoods:				
Shortleaf, loblolly pines.........	27,100	11.7	17,600	9,500
Virginia pine......................	57,500	24.8	31,500	26,000
Other softwoods....................	2,900	1.3	2,100	800
All softwoods..................	87,500	37.8	51,200	36,300
Hardwoods:				
Oak................................	74,900	32.3	57,100	17,800
Gums and yellowpoplar..............	50,400	21.8	39,400	11,000
Other hardwoods....................	18,800	8.1	14,300	4,500
All hardwoods..................	144,100	62.2	110,800	33,300
All species........................	231,600	100.0	162,000	69,600
SOUTHERN PIEDMONT				
Softwoods:				
Shortleaf, loblolly pines.........	128,700	32.8	98,400	30,300
Virginia pine......................	73,100	18.6	40,800	32,300
Other softwoods....................	3,600	.9	2,600	1,000
All softwoods..................	205,400	52.3	141,800	63,600
Hardwoods:				
Oak................................	83,600	21.3	63,500	20,100
Gums and yellowpoplar..............	73,000	18.6	55,800	17,200
Other hardwoods....................	30,900	7.8	24,400	6,500
All hardwoods..................	187,500	47.7	143,700	43,800
All species........................	392,900	100.0	285,500	107,400

Table 23. -- Current annual net growth of growing stock in cords, by tree species and forest condition, 1940

Tree species	All conditions		Saw-timber stands	Cordwood and repro-duction stands
	Cords	Percent	Cords	Cords
ENTIRE PIEDMONT				
Softwoods:				
Shortleaf, loblolly pines........	754,500	22.3	433,200	321,300
Virginia pine.....................	750,800	22.2	292,300	458,500
Other softwoods..................	43,400	1.3	25,500	17,900
All softwoods.................	1,548,700	45.8	751,000	797,700
Hardwoods:				
Oak..............................	825,300	24.4	473,700	351,600
Gums and yellowpoplar...........	598,800	17.7	368,200	230,600
Other hardwoods..................	410,500	12.1	229,700	180,800
All hardwoods.................	1,834,600	54.2	1,071,600	763,000
All species......................	3,383,300	100.0	1,822,600	1,560,700
NORTHERN PIEDMONT				
Softwoods:				
Shortleaf, loblolly pines........	150,100	11.4	71,800	78,300
Virginia pine.....................	336,700	25.5	119,200	217,500
Other softwoods..................	22,100	1.7	13,000	9,100
All softwoods.................	508,900	38.6	204,000	304,900
Hardwoods:				
Oak..............................	413,400	31.3	223,200	190,200
Gums and yellowpoplar...........	231,900	17.6	141,300	90,600
Other hardwoods..................	164,900	12.5	80,000	84,900
All hardwoods.................	810,200	61.4	444,500	365,700
All species......................	1,319,100	100.0	648,500	670,600
SOUTHERN PIEDMONT				
Softwoods:				
Shortleaf, loblolly pines........	604,400	29.3	361,400	243,000
Virginia pine.....................	414,100	20.1	173,100	241,000
Other softwoods..................	21,300	1.0	12,500	8,800
All softwoods.................	1,039,800	50.4	547,000	492,800
Hardwoods:				
Oak..............................	411,900	19.9	250,500	161,400
Gums and yellowpoplar...........	366,900	17.8	226,900	140,000
Other hardwoods..................	245,600	11.9	149,700	95,900
All hardwoods.................	1,024,400	49.6	627,100	397,300
All species......................	2,064,200	100.0	1,174,100	890,100

Table 24. -- Current annual net growth of cubic-foot growing stock, by tree species and forest condition, 1940

ENTIRE PIEDMONT

Tree species	All conditions		Saw-timber stands	Cordwood and reproduction stands
	M cu. ft.	Percent	M cu. ft	M cu. ft.
Softwoods:				
Shortleaf, loblolly pines.......	51,210	22.4	30,760	20,450
Virginia pine..................	57,290	25.1	22,490	34,800
Other softwoods................	3,230	1.4	1,890	1,340
All softwoods...............	111,730	48.9	55,140	56,590
Hardwoods:				
Oak............................	51,780	22.7	30,270	21,510
Gums and yellowpoplar..........	37,740	16.5	23,430	14,310
Other hardwoods................	27,200	11.9	15,690	11,510
All hardwoods...............	116,720	51.1	69,390	47,330
All species....................	228,450	100.0	124,530	103,920

NORTHERN PIEDMONT

Tree species	All conditions		Saw-timber stands	Cordwood and reproduction stands
Softwoods:				
Shortleaf, loblolly pines	10,050	11.3	5,100	4,950
Virginia pine..................	25,640	28.8	9,140	16,500
Other softwoods................	1,650	1.9	980	670
All softwoods...............	37,340	42.0	15,220	22,120
Hardwoods:				
Oak............................	25,740	29.0	14,170	11,570
Gums and yellowpoplar..........	14,580	16.4	8,950	5,630
Other hardwoods................	11,250	12.6	5,880	5,370
All hardwoods...............	51,570	58.0	29,000	22,570
All species....................	88,910	100.0	44,220	44,690

SOUTHERN PIEDMONT

Tree species	All conditions		Saw-timber stands	Cordwood and reproduction stands
Softwoods:				
Shortleaf, loblolly pines.......	41,160	29.5	25,660	15,500
Virginia pine..................	31,650	22.7	13,350	18,300
Other softwoods................	1,580	1.1	910	670
All softwoods...............	74,390	53.3	39,920	34,470
Hardwoods:				
Oak............................	26,040	18.7	16,100	9,940
Gums and yellowpoplar..........	23,160	16.6	14,480	8,680
Other hardwoods................	15,950	11.4	9,810	6,140
All hardwoods...............	65,150	46.7	40,390	24,760
All species....................	139,540	100.0	80,310	59,230

Table 25. -- Current annual net growth per acre, by forest type and condition, 1940

Forest type	All conditions		Saw-timber stands		Cordwood and reproduction stands	
	Bd. ft.	Cord	Bd. ft.	Cord	Bd. ft.	Cord
ENTIRE PIEDMONT						
Loblolly pine-hardwoods	150	0.69	262	0.98	31	0.38
Shortleaf pine-hardwoods	122	0.70	176	0.79	55	0.60
Virginia pine-hardwoods	102	0.63	182	0.79	60	0.56
Bottom-land hardwoods	130	0.67	183	0.79	59	0.52
Cove hardwoods	195	0.86	240	0.88	108	0.80
Upland hardwoods	96	0.51	145	0.58	55	0.44
All types	109	0.60	168	0.70	57	0.51
NORTHERN PIEDMONT						
Loblolly pine-hardwoods	30	0.26	88	0.42	......	0.18
Shortleaf pine-hardwoods	104	0.67	157	0.75	52	0.60
Virginia pine-hardwoods	92	0.64	177	0.76	54	0.58
Bottom-land hardwoods	118	0.63	169	0.76	59	0.48
Cove hardwoods	190	0.82	248	0.88	99	0.72
Upland hardwoods	91	0.50	141	0.56	49	0.45
All types	98	0.58	159	0.66	53	0.52
SOUTHERN PIEDMONT						
Loblolly pine-hardwoods	159	0.72	271	1.01	35	0.40
Shortleaf pine-hardwoods	126	0.71	181	0.80	55	0.59
Virginia pine-hardwoods	110	0.63	186	0.80	66	0.53
Bottom-land hardwoods	140	0.70	192	0.80	58	0.55
Cove hardwoods	203	0.91	230	0.88	127	0.99
Upland hardwoods	101	0.51	148	0.60	60	0.44
All types	116	0.62	174	0.73	61	0.51

Table 26. -- Saw-timber commodity drain, by product and tree species, 1940

Product	All species	Short-leaf and loblolly pine	Virginia pine	Other soft-woods	Oak	Gums and yellow-poplar	Other hard-woods
			ENTIRE PIEDMONT				
	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.
Sawlogs.........	360,800	185,400	61,500	3,200	58,700	49,300	2,700
Veneer logs.....	9,500	....	....	....	200	7,600	1,700
Cooperage bolts.	3,800	3,300	300	....	100	100	....
Hewn-tie bolts..	9,900	....	....	....	9,900	....	....
Pulpwood........	38,500	24,100	11,500	....	....	2,700	200
Fuel wood.......	37,200	14,000	12,700	....	7,300	1,600	1,600
Fence posts.....	4,500	....	100	2,600	1,400	....	400
Poles and piles.	2,400	2,300	....	....	....	....	100
All others......	1,900	400	....	300	400	100	700
All products..	468,500	229,500	86,100	6,100	78,000	61,400	7,400
			NORTHERN PIEDMONT				
Sawlogs.........	89,100	29,900	23,000	600	23,300	11,200	1,100
Veneer logs.....	2,200	....	....	....	....	1,300	900
Cooperage bolts.	700	500	200	....	....	....	....
Hewn-tie bolts..	2,600	....	....	....	2,600	....	....
Pulpwood........	16,000	6,000	8,000	....	....	1,900	100
Fuel wood.......	7,000	700	2,400	....	3,600	100	200
Fence posts.....	2,100	....	....	1,500	300	....	300
Poles and piles.	100	100	....	....	....	....	....
All others......	400	....	....	100	100	100	100
All products..	120,200	37,200	33,600	2,200	29,900	14,600	2,700
			SOUTHERN PIEDMONT				
Sawlogs.........	271,700	155,500	38,500	2,600	35,400	38,100	1,600
Veneer logs.....	7,300	....	....	....	200	6,300	800
Cooperage bolts.	3,100	2,800	100	....	100	100	....
Hewn-tie bolts..	7,300	....	....	....	7,300	....	....
Pulpwood........	22,500	18,100	3,500	....	....	800	100
Fuel wood.......	30,200	13,300	10,300	....	3,700	1,500	1,400
Fence posts.....	2,400	....	100	1,100	1,100	....	100
Poles and piles.	2,300	2,200	....	....	....	....	100
All others......	1,500	400	....	200	300	....	600
All products..	348,300	192,300	52,500	3,900	48,100	46,800	4,700

Table 27. -- Cubic-foot commodity drain, by product and tree species, 1940

ENTIRE PIEDMONT

Product	All species	Shortleaf and loblolly pine	Virginia pine	Other softwoods	Oak	Gums and yellow-poplar	Other hardwoods
	M cu.ft.	M cu.ft.	M cu.ft.	M cu.ft.	M cu.ft.	M cu.ft.	M cu.ft.
Sawlogs.........	82,190	44,280	15,270	610	11,910	9,550	570
Veneer logs.....	2,370	....	....	....	50	1,280	1,040
Cooperage bolts.	1,100	900	110	....	20	70	....
Hewn-tie bolts..	2,310	....	....	....	2,310	....	....
Pulpwood........	15,570	9,090	4,740	....	20	1,630	90
Fuel wood.......	35,870	6,530	9,380	....	12,930	3,080	3,950
Fence posts.....	3,520	10	20	1,340	600	....	1,550
Poles and piles.	610	590	....	....	....	....	20
All others......	570	160	....	100	100	10	200
All products	144,110	61,560	29,520	2,050	27,940	15,620	7,420

NORTHERN PIEDMONT

Product	All species	Shortleaf and loblolly pine	Virginia pine	Other softwoods	Oak	Gums and yellow-poplar	Other hardwoods
Sawlogs.........	21,220	7,670	6,120	120	5,040	2,030	240
Veneer logs.....	1,120	....	....	....	....	220	900
Cooperage bolts.	290	170	90	....	....	30	....
Hewn-tie bolts..	600	....	....	....	600	....	....
Pulpwood........	7,050	2,530	3,280	....	10	1,160	70
Fuel wood.......	7,970	470	1,590	....	4,620	240	1,050
Fence posts.....	1,900	....	....	760	130	....	1,010
Poles and piles.	30	30	....	....	....	....	....
All others......	140	10	....	50	30	10	40
All products..	40,320	10,880	11,080	930	10,430	3,690	3,310

SOUTHERN PIEDMONT

Product	All species	Shortleaf and loblolly pine	Virginia pine	Other softwoods	Oak	Gums and yellow-poplar	Other hardwoods
Sawlogs.........	60,970	36,610	9,150	490	6,870	7,520	330
Veneer logs.....	1,250	....	....	....	50	1,060	140
Cooperage bolts.	810	730	20	....	20	40	....
Hewn-tie bolts..	1,710	....	....	....	1,710	....	....
Pulpwood........	8,520	6,560	1,460	....	10	470	20
Fuel wood.......	27,900	6,060	7,790	....	8,310	2,840	2,900
Fence posts.....	1,620	10	20	580	470	....	540
Poles and piles.	580	560	....	....	....	....	20
All others......	430	150	....	50	70	....	160
All products..	103,790	50,680	18,440	1,120	17,510	11,930	4,110

Table 28. -- Net change in growing stock due to growth and drain, by forest condition and tree species and diameter class, 1940

ENTIRE PIEDMONT

Forest condition and tree species	Saw timber, of diameter (inches) --				All growing stock, of diameter (inches) --									
	All diameters	10-12	14-18	20 and larger	All diameters		6-8		10-12		14-18		20 and larger	
	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M cu.ft.	Percent	M cu.ft.	Percent	M cu.ft.	Percent	M cu.ft.	Percent	M cu.ft.	Percent
All conditions:														
Softwoods:														
Shortleaf, loblolly pines..	-73,700	-27,100	-28,900	-17,700	-10,350	-1.2	5,200	1.4	-7,930	-2.3	-4,410	-3.2	-3,210	-15.2
Virginia pine, other sftwds.	44,900	39,200	5,900	-200	28,950	4.6	15,850	4.7	11,120	5.0	1,930	3.0	50	0.8
All softwoods...........	-28,800	12,100	-23,000	-17,900	18,600	1.2	21,050	3.0	3,190	0.6	-2,480	-1.2	-3,160	-11.5
Hardwoods:														
Oak.......................	80,500	....	58,200	22,300	23,840	2.0	6,700	2.0	1,860	0.4	11,540	4.8	3,740	2.0
Gums and yellowpoplar......	62,000	....	43,000	19,000	22,120	3.9	8,380	5.2	4,290	2.2	6,700	4.4	2,750	4.0
Other hardwoods............	42,300	....	28,500	13,800	19,780	4.2	9,020	6.0	2,870	1.7	5,920	5.6	1,970	4.8
All hardwoods...........	184,800	....	129,700	55,100	65,740	2.9	24,100	3.8	9,020	1.1	24,160	4.9	8,460	2.8
All species................	156,000	12,100	106,700	37,200	84,340	2.3	45,150	3.4	12,210	0.9	21,680	3.1	5,300	1.6
Saw-timber stands:														
Softwoods:														
Shortleaf, loblolly pines..	-110,200	-55,600	-36,800	-17,800	-28,010	-3.9	-2,320	-1.0	-16,080	-5.0	-6,370	-4.8	-3,240	-15.6
Virginia pine, other sftwds.	-11,900	-14,900	3,200	-200	-2,630	-0.6	-880	-0.5	-2,880	-1.4	1,090	1.8	40	0.6
All softwoods...........	-122,100	-70,500	-33,600	-18,000	-30,640	-2.6	-3,200	-0.8	-18,960	-3.6	-5,280	-2.7	-3,200	-11.8
Hardwoods:														
Oak.......................	44,400	....	24,400	20,000	11,070	1.3	3,660	2.2	-660	-0.3	4,730	2.1	3,340	1.8
Gums and yellowpoplar......	34,200	....	16,500	17,700	10,320	2.3	3,660	3.7	1,350	1.0	2,760	1.9	2,550	3.7
Other hardwoods............	31,500	....	18,100	13,400	12,030	3.4	4,460	4.8	2,020	1.7	3,670	3.8	1,880	4.6
All hardwoods...........	110,100	....	59,000	51,100	33,420	2.0	11,780	3.3	2,710	0.5	11,160	2.4	7,770	2.6
All species................	-12,000	-70,500	25,400	33,100	2,780	0.1	8,580	1.1	-16,250	-1.5	5,880	0.9	4,570	1.4
Cordwood, reproduction stands:														
Softwoods:														
Shortleaf, loblolly pines..	36,500	28,500	7,900	100	17,660	11.6	7,520	6.2	8,150	31.4	1,960	59.6	30	8.3
Virginia pine, other sftwds.	56,800	54,100	2,700	....	31,580	17.4	16,730	10.4	14,000	76.0	840	41.6	10	.....
All softwoods...........	93,300	82,600	10,600	100	49,240	14.8	24,250	8.6	22,150	49.9	2,800	52.7	40	11.1
Hardwoods:														
Oak.......................	36,100	....	33,800	2,300	12,770	3.6	3,040	1.9	2,520	1.4	6,810	40.0	400	61.5
Gums and yellowpoplar......	27,800	....	26,500	1,300	11,800	9.8	4,720	7.4	2,940	6.0	3,940	55.0	200	25.3
Other hardwoods............	10,800	....	10,400	400	7,750	6.9	4,560	8.0	850	1.8	2,250	30.2	90	12.5
All hardwoods...........	74,700	....	70,700	4,000	32,320	5.5	12,320	4.4	6,310	2.3	13,000	41.1	690	31.9
All species................	168,000	82,600	81,300	4,100	81,560	8.9	36,570	6.5	28,460	9.0	15,800	42.7	730	29.0

Table 28. -- Net change in growing stock due to growth and drain, by forest condition and tree species and diameter class, 1940 -- Continued

NORTHERN PIEDMONT

Forest condition and tree species	Saw timber, of diameter (inches) --				All growing stock, of diameter (inches) --									
	All diameters	10-12	14-18	20 and larger	All diameters		6-8		10-12		14-18		20 and larger	
	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M cu.ft.	Percent	M cu.ft.	Percent	M cu.ft.	Percent	M cu.ft.	Percent	M cu.ft.	Percent
All conditions:														
Softwoods:														
Shortleaf, loblolly pines..	-10,100	-1,100	-7,900	-1,100	-830	-0.5	1,360	1.7	-390	-0.6	-1,570	-6.7	-230	-7.4
Virginia pine,other sftwds.	24,600	18,500	4,700	1,400	15,280	5.6	8,850	6.0	4,740	5.1	1,370	5.0	320	11.2
All softwoods...........	14,500	17,400	-3,200	300	14,450	3.3	10,210	4.5	4,350	2.7	-200	-0.4	90	1.5
Hardwoods:														
Oak......................	45,000	....	27,200	17,800	15,310	2.6	4,400	2.8	2,450	1.1	5,460	4.5	3,000	3.3
Gums and yellowpoplar......	35,800	....	23,800	12,000	10,890	5.6	3,480	6.4	2,250	3.3	3,570	7.1	1,590	7.0
Other hardwoods...........	16,100	....	10,500	5,600	7,940	4.4	3,960	6.7	1,440	2.2	2,040	5.4	500	3.0
All hardwoods...........	96,900	....	61,500	35,400	34,140	3.6	11,840	4.4	6,140	1.8	11,070	5.3	5,090	3.9
All species................	111,400	17,400	58,300	35,700	48,590	3.5	22,050	4.4	10,490	2.1	10,870	4.2	5,180	3.8
Saw-timber stands:														
Softwoods:														
Shortleaf, loblolly pines..	-19,000	-7,800	-10,100	-1,100	-5,290	-4.0	-460	-1.0	-2,460	-4.1	-2,140	-9.5	-230	-7.4
Virginia pine,other sftwds.	-600	-5,500	3,500	1,400	-390	-0.2	-10	negl.	-1,580	-1.8	880	3.3	320	11.2
All softwoods...........	-19,600	-13,300	-6,600	300	-5,680	-1.8	-470	-0.4	-4,040	-2.7	-1,260	-2.6	90	1.5
Hardwoods:														
Oak......................	28,100	....	11,700	16,400	6,780	1.7	1,610	2.2	90	0.1	2,320	2.0	2,760	3.1
Gums and yellowpoplar......	24,900	....	13,500	11,400	5,730	3.8	1,460	4.8	540	1.1	2,220	4.6	1,510	6.7
Other hardwoods...........	11,700	....	6,200	5,500	4,050	3.1	1,690	5.0	790	1.7	1,110	3.1	460	2.9
All hardwoods...........	64,700	....	31,400	33,300	16,560	2.4	4,760	3.4	1,420	0.7	5,650	2.8	4,730	3.7
All species................	45,100	-13,300	24,800	33,600	10,880	1.1	4,290	1.7	-2,620	-0.7	4,390	1.8	4,820	3.6
Cordwood,reproduction stands:														
Softwoods:														
Shortleaf, loblolly pines..	8,900	6,700	2,200	....	4,460	11.6	1,820	5.7	2,070	35.4	570	55.3	....	....
Virginia pine,other sftwds.	25,200	24,000	1,200	....	15,670	19.3	8,860	11.8	6,320	114.1	490	63.6	....	....
All softwoods...........	34,100	30,700	3,400	....	20,130	16.8	10,680	10.0	8,390	73.7	1,060	58.9	....	....
Hardwoods:														
Oak......................	16,900	....	15,500	1,400	8,530	4.6	2,790	3.3	2,360	2.5	3,140	41.9	240	80.0
Gums and yellowpoplar......	10,900	....	10,300	600	5,160	11.6	2,020	8.4	1,710	9.1	1,350	81.8	80	50.0
Other hardwoods...........	4,400	....	4,300	100	3,890	8.0	2,270	9.1	650	3.1	930	39.2	40	11.1
All hardwoods...........	32,200	....	30,100	2,100	17,580	6.3	7,080	5.4	4,720	3.5	5,420	47.1	360	43.9
All species................	66,300	30,700	33,500	2,100	37,710	9.5	17,760	7.4	13,110	9.1	6,480	48.7	360	43.9

Table 28. -- Net change in growing stock due to growth and drain, by forest condition and tree species and diameter class, 1940 -- Continued

SOUTHERN PIEDMONT

Forest condition and tree species	Saw timber, of diameter (inches) --				All growing stock, of diameter (inches) --									
	All diameters	10-12	14-18	20 and larger	All diameters		6-8		10-12		14-18		20 and larger	
	M bd.ft.	M bd.ft.	M bd.ft.	M bd.ft.	M cu.ft.	Percent	M cu.ft.	Percent	M cu.ft.	Percent	M cu.ft.	Percent	M cu.ft.	Percent
All conditions:														
Softwoods:														
Shortleaf, loblolly pines..	-63,600	-26,000	-21,000	-16,600	-9,520	-1.4	3,840	1.4	-7,540	-2.7	-2,840	-2.5	-2,980	-16.6
Virginia pine, other sftwds.	20,300	20,700	1,200	-1,600	13,670	3.8	7,000	3.6	6,380	5.0	560	1.5	-270	-7.5
All softwoods...........	-43,300	-5,300	-19,800	-18,200	4,150	0.4	10,840	2.3	-1,160	-0.3	-2,280	-1.5	-3,250	-15.1
Hardwoods:														
Oak.......................	35,500	....	31,000	4,500	8,530	1.4	2,300	1.4	-590	-0.3	6,080	5.2	740	0.7
Gums and yellowpoplar......	26,200	....	19,200	7,000	11,230	3.0	4,900	4.6	2,040	1.7	3,130	3.1	1,160	2.5
Other hardwoods...........	26,200	....	18,000	8,200	11,840	4.1	5,060	5.6	1,430	1.4	3,880	5.8	1,470	5.9
All hardwoods...........	87,900	....	68,200	19,700	31,600	2.5	12,260	3.3	2,880	0.6	13,090	4.6	3,370	2.0
All species.................	44,600	-5,300	48,400	1,500	35,750	1.5	23,100	2.7	1,720	0.2	10,810	2.5	120	0.1
Saw-timber stands:														
Softwoods:														
Shortleaf, loblolly pines..	-91,200	-47,800	-26,700	-16,700	-22,720	-3.9	-1,860	-1.0	-13,620	-5.2	-4,230	-3.8	-3,010	-17.1
Virginia pine, other sftwds.	-11,300	-9,400	-300	-1,600	-2,240	-0.9	-870	-0.8	-1,300	-1.1	210	0.6	-280	-7.8
All softwoods...........	-102,500	-57,200	-27,000	-18,300	-24,960	-3.0	-2,730	-0.9	-14,920	-3.9	-4,020	-2.8	-3,290	-15.5
Hardwoods:														
Oak.......................	16,300	....	12,700	3,600	4,290	1.0	2,050	2.2	-750	-0.5	2,410	2.2	580	0.6
Gums and yellowpoplar......	9,300	....	3,000	6,300	4,590	1.5	2,200	3.3	810	0.9	540	0.6	1,040	2.3
Other hardwoods...........	19,800	....	11,900	7,900	7,980	3.6	2,770	4.7	1,230	1.6	2,560	4.1	1,420	5.8
All hardwoods...........	45,400	....	27,600	17,800	16,860	1.7	7,020	3.2	1,290	0.4	5,510	2.1	3,040	1.8
All species.................	-57,100	-57,200	600	-500	-8,100	-0.4	4,290	0.8	-13,630	-2.0	1,490	0.4	-250	-0.1
Cordwood, reproduction stands:														
Softwoods:														
Shortleaf, loblolly pines..	27,600	21,800	5,700	100	13,200	11.7	5,700	6.3	6,080	30.2	1,390	61.5	30	8.3
Virginia pine, other sftwds.	31,600	30,100	1,500	....	15,910	15.9	7,870	9.2	7,680	59.6	350	28.0	10	.....
All softwoods...........	59,200	51,900	7,200	100	29,110	13.7	13,570	7.7	13,760	41.6	1,740	49.6	40	11.1
Hardwoods:														
Oak.......................	19,200	....	18,300	900	4,240	2.5	250	0.3	160	0.2	3,670	38.5	160	45.7
Gums and yellowpoplar......	16,900	....	16,200	700	6,640	8.8	2,700	6.8	1,230	4.1	2,590	46.9	120	19.0
Other hardwoods...........	6,400	....	6,100	300	3,860	6.0	2,290	7.2	200	0.7	1,320	25.9	50	13.9
All hardwoods...........	42,500	....	40,600	1,900	14,740	4.8	5,240	3.5	1,590	1.1	7,580	37.6	330	24.6
All species.................	101,700	51,900	47,800	2,000	43,850	8.4	18,810	5.8	15,350	8.9	9,320	39.4	370	21.8

Table 29. -- Production or consumption of timber by primary forest industries, 1940

ENTIRE PIEDMONT

Industry	Number of estab- lish- ments	Unit of measure	Production or consumption, by species						
			All species	Short- leaf and loblolly pines	Vir- ginia pine	Other soft- woods	Oak	Gums and yellow- poplar	Other hard woods
Lumber......	1,196	Mil.b.f.	382.8	197.4	67.2	3.2	60.1	52.0	2.9
Veneer......	3	Mil.b.f.	8.4	....	.....	.....	0.3	7.2	0.9
Cooperage...	17	M cords	17.7	15.2	1.3	.....	0.4	0.8	.....
Hewn ties...	......	M pieces	207	....	.....	.....	207	....	.....
Fuel wood...	......	M cords	1,674.8	322.8	293.3	.....	713.8	159.3	185.6
Fence posts.	......	M cords	57.1	0.1	0.3	18.4	10.3	....	28.0
Poles, piles	......	M pieces	22	22	.....	.....	.....	....	.....
All others..	15	M cords	86.0	16.6	1.6	12.5	1.6	0.4	53.3

NORTHERN PIEDMONT

Industry	Number of estab- lish- ments	Unit of measure	All species	Short- leaf and loblolly pines	Vir- ginia pine	Other soft- woods	Oak	Gums and yellow- poplar	Other hard woods
Lumber......	322	Mil.b.f.	93.4	31.0	25.7	0.6	23.6	11.3	1.2
Veneer......	......	Mil.b.f.	....	....	.....	.....	.....	....	.....
Cooperage...	5	M cords	3.9	2.6	1.1	.....	.....	0.2	.....
Hewn ties...	......	M pieces	54	....	.....	.....	54	....	.....
Fuel wood...	......	M cords	642.0	53.4	100.4	.....	379.0	30.2	79.0
Fence posts.	......	M cords	31.5	....	.....	10.2	2.3	....	19.0
Poles, piles	......	M pieces	1	1	.....	.....	.....	....	.....
All others..	4	M cords	3.7	1.1	0.6	.....	0.4	0.2	1.4

SOUTHERN PIEDMONT

Industry	Number of estab- lish- ments	Unit of measure	All species	Short- leaf and loblolly pines	Vir- ginia pine	Other soft- woods	Oak	Gums and yellow- poplar	Other hard woods
Lumber......	874	Mil.b.f.	289.4	166.4	41.5	2.6	36.5	40.7	1.7
Veneer......	3	Mil.b.f.	8.4	....	.....	.....	0.3	7.2	0.9
Cooperage...	12	M cords	13.8	12.6	0.2	.....	0.4	0.6	.....
Hewn ties...	......	M pieces	153	....	.....	.....	153	....	.....
Fuel wood...	......	M cords	1,032.8	269.4	192.9	.....	334.8	129.1	106.6
Fence posts.	......	M cords	25.6	0.1	0.3	8.2	8.0	....	9.0
Poles, piles	......	M pieces	21	21	.....	.....	.....	....	.....
All others..	11	M cords	82.3	15.5	1.0	12.5	1.2	0.2	51.0

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